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Final Draft Guidance for Subpart G of the Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities

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Final Draft Guidance for Subpart G Of the Interim Status Standards For Owners and Operators Of Hazardous Waste Treatment, Storage and Disposal Facilities

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-clarify the concepts, definitions and rationale behind the requirements;
-identify the major issues that affect closure and post-closure requirements;
-discuss site-specific factors that affect closure and post-closure plans;
-clarify the role of the Regional office in evaluating these plans;
-provide guidance to owners or operators who need to develop closure and post-closure plans.

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PREFACE

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PREFACE

This draft guidance document has been prepared by the International Research and Technology Corporation. In preparing this document, we have sought and incorporated the advice of the Office of Solid Waste, Environmental Protection Agency (EPA). The Regional Offices, the Office of General Counsel and the Office of Enforcement have not yet reviewed this draft guidance document; therefore, this document does not represent EPA's final views and opinions.

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1.0 INTRODUCTION

The EPA has developed closure and post-closure performance standards as part of the Interim Status Standards -- Subpart G, Closure and Post-Closure Requirements. This guidance document accompanies only those portions of the regulations which were issued on May 19, 1980 and the Technical Amendments to those regulations. It should be noted that several sections are interim final regulations and are subject to change at a later date. Additional guidance will be provided when these interim final regulations become final to reflect any future changes. This document provides guidance for the following portions of the regulations:

§265.111 - Closure performance standards (Interim final)
§265.112 - Closure plan; amendment of plan (Interim final)
§265.113 - Time allowed for closure (Interim final)
§265.114 - Disposal or decontamination of equipment
§265.115 - Certification of closure
§265.117 - Post-closure care and use of property; period of care (Interim final)
§265.118 - Post-closure plan; amendment of plan (Interim final)
§265.119 - Notice to local land authority
§265.120 - Notice in deed to property

The EPA has developed the closure performance standards to ensure that all hazardous waste management facilities are closed "in a manner that (1) minimizes the need for further maintenance, and (2) controls, minimizes or eliminates, to the extent necessary to protect human health and the environment, post-closure escape of hazardous waste, hazardous waste constituents, leachate, contaminated rainfall, or waste decomposition products to the ground water, or surface waters, or to the atmosphere."* As part of these closure requirements, an owner or operator of a hazardous waste treatment, storage or disposal facility must develop a closure plan which "will identify the steps necessary to completely close the facility at any point during its intended life and at the end of its intended life."** The closure plans for treatment and storage facilities must be available on the premises of a facility on the effective date of these regulations, i.e., November 19, 1980. Owners or operators of land disposal facilities, or facilities closed as land disposal facilities, must have their closure plans available until 12 months after the promulgation of these regulations, i.e., May 19, 1981. The owner or operator of a surface impoundment may close it as either a landfill or a storage or treatment facility. To close without being responsible for post-closure care, he must either (1) remove all hazardous wastes and residues, the liner, and underlying and surrounding contaminated soil, or (2) show that any wastes removed are not hazardous.

In addition to the closure regulations, the EPA has developed post-closure care regulations which apply to the owners or operators of all facilities designed for waste disposal, i.e., facilities at which wastes remain after closure. These facilities require ground-water monitoring and maintenance of the monitoring and waste containment systems for a period of years after operations have ceased. As part of these requirements, an owner or operator must prepare a post-closure plan which "must identify the activities which will be carried on after final closure and the frequency of those activities."*** The post-closure plan must be available six months after the effective date of the regulations.

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*EPA Interim Status Standards, 40 CFR §265.111.

**EPA Interim Status Standards, 40 CFR §265.112(a).

***EPA Interim Status Standards, 40 CFR §265.118(a).

The closure and post-closure plans are required in order to ensure that adequate preparations have been made for closure and, if applicable, post-closure care. Additionally, these plans are the basis for the closure and post-closure cost estimates required as part of §§265.142(a) and 265.144(a).

The purpose of this guidance document is to assist the Regional Office in implementing those sections of the regulation relevant to closure and post-closure plans. This document will:

- Clarify the concepts, definitions and rationale behind the requirements;
- Identify the major issues that affect closure and post-closure requirements;
- Discuss site-specific factors that affect closure and post-closure plans;
- Clarify the role of the Regional Office in evaluating these plans;
- Provide examples of the kinds of information that might be appropriate for closure and post-closure plans; and
- Provide guidance to owners or operators who need to develop closure and post-closure plans.

The remainder of this document is divided into the following sections: basic rules for developing closure and post-closure plans; guidance for developing closure and post-closure plans; revising closure and post-closure plans; adequacy of closure and post-closure plans; and implementing closure and post-closure during interim status.

All hazardous waste treatment, storage, or disposal facilities (TSDF) are required to have closure and, if applicable, post-closure plans. This document concentrates on the closure plans specific to six types of TSDF's: tanks; surface impoundments; land treatment facilities; landfills; incinerators; and multiple process facilities. Although there are no sections devoted specifically to closure and, if applicable, post-closure requirements for containers, waste piles, thermal treatment facilities, and chemical, physical and biological treatment facilities, the basic principles still apply. For example, some of the closure requirements that are discussed in the section on incinerators will also apply to thermal treatment facilities; similarly, an owner or operator of a chemical, physical and biological treatment facility may find portions of the section on surface impoundments relevant to his facility. An owner or operator of a multiple process facility may prepare a closure plan for each individual portion of the facility or one combining the various facilities.

With the exception of multiple process facilities, a closure plan outline has been included for each of these types of facilities to provide further clarification and to illustrate one possible example of documentation. A post-closure outline is included in Section 10.0, Post-Closure Guidance, for similar illustrative purposes. Section 9.0 provides a general discussion of closure and post-closure measures which might be necessary at some facilities to ensure the protection of human health and the environment.

The emphasis throughout this document is upon the interim status situation. This is particularly important to the sections on adequacy of closure and post-closure plans, which are designed for rapid review and inspection. Much of the material contained in this document is repetitive. In order to ensure that the guidance relevant to each type of facility is autonomous, it is necessary to repeat many of the concepts that are generic to more than one type of facility.

2.0 BASIC RULES FOR DEVELOPING CLOSURE AND POST-CLOSURE PLANS

2.1 DETERMINING THE TECHNICAL ADEQUACY OF CLOSURE AND POST-CLOSURE PLANS FOR LANDFILLS, SURFACE IMPOUNDMENTS AND LAND TREATMENT FACILITIES

(RESERVED)

2.2 BASIC RULES FOR DEVELOPING CLOSURE PLANS

The purpose of the closure plan is to ensure that an owner or operator has considered and prepared for all that is necessary to adequately close his particular facility with its site-specific conditions. The closure period begins at the time of the final acceptance of waste and is considered completed, from the standpoint of technical requirements, when closure, in accordance with the closure plan, is certified by a professional engineer. The Agency understands that facilities are very site-specific with respect to their operational procedures, the wastes handled, and steps required to adequately close a facility, and has not stipulated specific technical requirements for closure. The closure plan, therefore, serves as the mechanism for the owner or operator to describe the most appropriate methods and procedures, given all of the site-specific factors, to complete all of the activities necessary to close the facility in a manner that will minimize the threat of danger to human health and the environment. The closure plan, by describing the steps necessary to close the facility and site-specific factors affecting these steps, will provide the EPA Regional Administrator with a basis for evaluating the adequacy of the proposed plans for closure.

Although all facilities will have site-specific closure plans, all closure plans must provide, at a minimum:*

(1) A description of how and when the facility will be partially closed, if applicable, and ultimately closed, including an estimate of the maximum extent of the operation which will be open at any point during the life of the facility;

(2) An estimate of the maximum inventory of wastes in storage or treatment at any time;

(3) A description of steps necessary to decontaminate the facility or render it non-hazardous at closure; and

(4) A schedule for final closure activities.

A closure plan which is developed in accordance with the objectives stated above must include certain kinds of activities which are applicable to all types of facilities. Application to specific situations will be discussed further in the separate sections on each type of facility. The following clarifies what is intended by the requirements.

2.2. "Active" Portions of a Facility

The closure and, if applicable, post-closure regulations only apply to those portions of the facility which are active on the effective date of these regulations. An active portion is often defined as "that portion of a facility where treatment, storage, or disposal operations are being or have been conducted after the effective date of Part 261 of this Chapter and which is not a closed portion."** If a landfill cell is active on the effective date of the regulations, the entire cell must be closed in accordance with the regulations.

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*EPA Interim Status Standards, 40 CFR §265.112(a).

**EPA Interim Status Standards, 40 CFR §260.10(a)(2).

2.2.2 "Maximum Extent of Operation"

The closure plan, which identifies the steps necessary to close the facility at any point during its expected life, must include any steps that would likely be required to close "the maximum extent of the operation which will be unclosed during the life of the facility."* The plan will include those activities necessary if the facility suddenly has to stop receiving wastes and begin closure. The closure plan must be written so that if an inspector came onto the facility, none of the conditions observed would exceed those stated in the plan. Any time an owner or operator exceeds his estimate, he must revise his closure plan to reflect his new estimate of the maximum extent of operation. Although this assumption and description of requirements may differ significantly from what an owner or operator hopes will be required at the expected time of closure, the Agency believes that it is desirable to have available such a plan in the event of forced closure due to an unforeseen event, e.g., business failure of the facility owner or operator. The conditions assumed at closure and the steps that will be required should therefore be the maximum extent ever likely over the life of the facility. For example, an estimate of the maximum extent of operation would include: the maximum area of a landfill ever open, including areas inactive but open because of operating problems; the most extensive amount of cleanup likely to be required; and the most extensive inventory ever on hand. In the case of a land treatment facility, the maximum extent of operation would be based on the assumption that the maximum amount of land had been recently spread with hazardous waste.

Although the plan is to account for the maximum extent of operation, it need not include provisions for highly unusual contingencies, unless they affect the conditions of the facility at the time the owner or operator prepares the closure plan. (This obviously is a problem unique to facilities operating under interim status which may already have experienced problems during previous operations.) For example, the closure plan does not need to account for the effects of the 50-year flood or liner failure in a large cell (e.g., extensive construction and cleanup activities) unless such contingencies affect the facility conditions when the plan is written. If an owner or operator does exceed his estimate of maximum extent of operation over the life of the facility, he "must amend his plan any time changes in operating plans or facility design affect the closure plan."* Under some circumstances, if the owner or operator can justify to the Regional Administrator that the change in conditions was caused by an unlikely contingency, and conditions, as described in the plan, will be restored within a short time, he may not be required to revise his plan.

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*EPA Interim Status Standards, 40 CFR §265.112(a)(1).

An owner or operator of a land treatment facility should, based on his operating experience, assume for his closure plan that: (1) all hazardous materials will be rendered non-hazardous by the completion of the closure period; (2) hazardous constituents will remain at closure and the contaminated soil will be removed; or (3) hazardous constituents will remain when closure is completed and the facility will be stabilized to control waste migration.

The original closure plan should describe the activities necessary to close the maximum extent of operation, assuming one of the three options described above. If an owner or operator changes his assumption about the conditions at the facility at the time closure is completed, or changes his procedures, he must revise his closure plan to reflect current requirements. For example, if as a result of testing required in Section 265.278 an owner or operator finds that the treatment is not rendering the wastes non-hazardous, and he based his original plan on the assumption that there would be no hazardous wastes at the completion of closure, he would need to either plan to remove all contaminated soil or stabilize the facility and provide for post-closure care. He would also need to prepare a post-closure plan if the hazardous wastes were to remain at the facility after closure. Similarly, if an owner or operator decided to stabilize the facility and provide for post-closure care instead of removing all contaminated soils, he would need to revise his original plan and prepare a post-closure plan as soon as he changed his original assumptions.

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* A Interim Status Standards, 40 CFR §265.112(b).

2.2.3 Partial Closure

It is common practice and environmentally desirable for owners or oeprators of certain types of facilities (e.g., landfills and surface impoundments) to periodically perform certain closure requirements during the course of operations. For example, portions of a landfill are usually capped as they are filled which reduces the size of the area to be closed at final closure. The regulations require that an owner or operator include in his closure plan "a description of how and when the facility will be partially closed, if applicable, and ultimately closed."* All partial closure activities must be in accordance with the closure regulations and included in the closure plan.

The owner or operator must also describe the activities required to close the maximum area open at any given time. The maximum area open is directly affected by the partial closure schedule and the extent of the partial closure activities. It is conceivable that if an owner or operator closed areas as they were filled and operations went exactly as expected, little would need to be done at final closure. It must be assumed for the closure plan, however, that, at closure, the maximum area open at any time will need to be closed to account for the maximum extent of operation; therefore, it should be assumed that closure occurs just prior to such an activity (e.g., periodic capping) which would reduce closure requirements. For example, if a landfill operator routinely fills one cell at a time and covers it with a clay cap and vegetation, the closure plan should include a description of the procedures needed to close that cell and an indicator that one cell represents the maximum extent of operation open at any time. If vegetation is not planted and maintained on cells previously closed, the discussion of the maximum extent of operations should also include a description of procedures for vegetating the entire facility or the largest area requiring vegetation at closure. In summary, an adequate closure plan will include a description and schedule of all partial closures and activities that will be necessary at final closure. The owner or operator must ensure that if at any time an inspector came onto the facility, the maximum conditions assumed in the closure plan would not be exceeded.

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*EPA Interim Status Standards, 40 CFR §265.112(a)(1).

2.2.4 Maximum Inventory of Wastes

All owners or operators will be required, as part of closure, to treat or dispose on-site or remove to an off-site TSDF all wastes accumulated at the time of closure. The closure plan must include "an estimate of the maximum inventory of wastes in storage or in treatment at any given time during the life of the facility."* The plan should also include a description of the procedures for treating or removing these wastes to ensure that, in the event of an early or unexpected closure, the owner or operator has made plans to remove, treat, or dispose of the maximum amount of waste on-site.

Inventory is defined as all undisposed hazardous wastes at all stages of processing, and residues from the actual processes involved with the facility's operations. For purposes of the closure plan, the maximum closure inventory is a hypothetical inventory of the maximum amount of waste in storage or treatment at any time during the life of the facility, including all inventory that will likely accumulate under normal conditions. Certain types of facilities may not routinely accumulate wastes as part of operating procedures; for example, an owner or operator of a land treatment facility may spread wastes directly from a truck onto the land and may therefore have no inventory.

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*EPA Interim Status Standards, 40 CFR §265.112(a)(2).

In developing an estimate of maximum inventory ever on-site over the life of the facility, an owner or operator must take into account expected periodic accumulations of inventory and predictable events that will likely affect operating procedures over the life of the facility. For example, an owner or operator may, as part of routine operations, cyclically accumulate inventory over a certain period and then work it off. The estimate of the maximum amount ever on-site, in this case, would be the maximum amount ever accumulated. This estimate should also incorporate inventory that will likely accumulate as a result of predictable conditions, such as adverse winter weather conditions, which affect landfilling activities, and periodic "down times" to rebrick an incinerator. The estimate does not need to account for large accumulations of inventory caused by unusual contingencies, such as the 50-year flood or liner failures, unless they affect the amount of inventory at the time the owner or operator prepares the closure plan.

The estimate of maximum inventory must always be high enough to include all inventory on-site at the time the plan is prepared. If unusual events occur over the life of the facility and cause the original estimate to be exceeded, the owner or operator must revise the estimate to reflect current conditions unless he can justify to the Regional Administrator that the inventory accumulation was caused by an unlikely contingency and the amount will be reduced to the original estimate within a short time.

For a tank or surface impoundment facility, the term "removal of inventory" has a somewhat different meaning. The estimate of the maximum inventory includes the maximum amount of hazardous wastes ever in the tank or impoundment and the associated residues and containers. If the wastes in the tank or impoundment are not considered hazardous, the owner or operator is not required to treat or dispose of them as hazardous wastes. The plan must also include a description of how and where the wastes ultimately will be treated or disposed. A surface impoundment may or may not be a disposal facility, i.e., a facility in which wastes remain after closure; if all hazardous wastes are to be removed from the impoundment as part of closure, removal of all inventory refers to the processes of removing and disposing of all liquids, sludges, liners, and contaminated soils in the impoundment.

Procedures for Removing the Maximum Inventory

The closure plan must contain a description of procedures for removing inventory assuming that the maximum amount will need to be treated, removed or disposed. The regulations restrict the time allotted for treating, removing or disposing of inventory to 90 days.

Although requiring all inventory to be managed within 90 days does not restrict the amount that could accumulate, since an unlimited amount could theoretically be removed off-site, it does ensure that an owner or operator has prepared for treating, disposing or sending hazardous waste off-site in a timely fashion. Since most environmental damage caused by improperly operated waste facilities has begun as a result of excessive accumulation of wastes on-site without proper plans for timely management, the closure plan must provide detailed descriptions of procedures for treating, removing or disposing of the inventory.

In addition to the environmental advantages of limiting inventory, it is also advantageous to the owner or operator to limit the amount of inventory. Since all inventory must be treated, disposed or removed within 90 days, the more inventory an owner or operator has on hand, the more intensive the activities necessary to ensure that all wastes are managed within 90 days. If the owner or operator accumulated an excessive amount of inventory and could not reasonably expect to treat or dispose of it all within 90 days, he would need to send the wastes to an off-site TSDF which is more costly than on-site treatment or disposal.

The Regional Office should use discretion in determining whether or not an owner or operator is justified in taking longer than 90 days to treat, remove or dispose of all inventory. For example, if liquids are routinely removed from a surface impoundment by evaporation, it may not be possible to complete the process within 90 days from receiving final wastes. Similarly, an owner or operator may be unable to complete land treatment within that time frame.

The maximum amount of inventory on-site includes all wastes requiring pretreatment, and procedures will thus include all processes required prior to final treatment or disposal. In most cases, it is likely that wastes awaiting disposal will require varying degrees of processing and treatment. At an incineration facility, for example, all wastes may be incinerated on-site and the residues will be hauled off-site; at a landfill facility, some wastes may require different degrees and types of treatment prior to disposal, while other wastes may be removed to an off-site TSDF if enough trenches have not been constructed. In both cases, the plan will describe in detail the various procedures to be followed, including treatment and disposal methods and an estimate of the likely proximity of the ultimate treatment or disposal facility.

An owner or operator of a treatment or storage facility may indicate in his closure plan that he will dispose of wastes on-site if it is a multiple process facility with disposal capabilities. It is esential to note, however, that such an owner or operator may dispose of wastes in a landfill on-site *only* if the landfill is already operating under interim status or is permitted. Under no circumstances may an owner or operator build a landfill at the time he closes the treatment or storage facility in order to dispose of wastes on-site.

2.2.5 Decontaminating the Facility

"When closure is completed, all facility equipment and structures must have been properly disposed of, or decontaminated by removing all hazardous waste and residues."* This includes, but is not limited to, the equipment, and facilities used for earth-moving and storage, processing, treatment, and disposal of wastes and residues, including any contaminated soil from drips and spills. Decontaminating the facility is not intended to involve highly complex mechanical activities; rather, for a well operated facility it should include routine cleaning procedures. The closure plan will contain a description of all of the equipment and facilities affected and procedures for decontamination, which may include proposed methods for cleaning equipment, soil testing, and removing and disposing of contaminated soil, cleaning residues, and fluids. Requiring a description of procedures needed to decontaminate the facility ensures that the owner or operator is aware of all of the equipment and surrounding area that requires cleaning and has a plan for such cleanup.

2.2.6 Schedule for Final Closure

The closure plan must include a schedule of all activities required to completely close the facility, including intervening activities which contribute to final closure. All closure activities should be completed within six months of receiving the final volume of wastes unless the Regional Administrator approves a longer period. The schedule of closure activities should include:

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*EPA Interim Status Standards, 40 CFR §265.114.

- The final date that wastes will be accepted;
- The final date of completed closure;
- Dates for completion of activities performed during final closure (e.g., dates for completing the treatment and disposal of all wastes on-site, removing all residual wastes in storage facilities, decontaminating the facility, completing final capping, and planting vegetation); and
- Dates for any partial closure activities.

A schedule of these periodic activities is required to ensure that if an estimate of the maximum area ever conceivably open at a facility is based on periodic activities, these activities are performed with the scheduled regularity. This, again, is to ensure that the closure plan is based on the maximum area of the facility ever open and the maximum extent of activities required to close the facility.

"The owner or operator must complete closure activities in accordance with the approved closure plan and within six months after receiving the final volume of wastes. The Regional Administrator may approve a longer closure period under §265.112(c) if the owner or operator can demonstrate that: (1) the required or planned closure activities will, of necessity, take him longer than six months to complete, and (2) that he has taken all steps to eliminate any significant threat to human health and the environment from the unclosed but inactive facility."*

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*EPA Interim Status Standards, 40 CFR §265.113(b).

The Agency believes that, at most facilities, it should be possible to complete closure within six months. Given site-specific conditions, however, the regulations allow for a longer closure period if an extension is justified. For example, closure activities at a land treatment facility are completed when the wastes are rendered non-hazardous or less hazardous; this may not be achievable within six months. If an owner or operator, as part of normal operations, removes liquids from a surface impoundment by evaporation, it may of necessity take longer than six months to complete closure. Assuming an owner or operator is operating in accordance with the regulations and is justified in requesting an extension, the Regional Office should approve a longer closure period

The owner or operator must ensure that he has taken the appropriate steps to eliminate any significant threat to human health and the environment. It is intended that the owner or operator should continue those activities normally performed to protect against pollution. This section of the regulation allows the Regional Administrator to specify additional requirements if adequate precautions are not being taken.

2.2.7 Monitoring

In addition to the above requirements, all owners or operators who are required to monitor their facility during operation must continue to do so throughout the closure period, since the facility still contains wastes and poses a potential ground-water, surface water, or air quality threat. If the facility is a permanent waste repository, ground-water monitoring will also continue throughout post-closure until the Regional Administrator determines that the monitoring may be terminated.

The closure plan must include provisions for ground-water monitoring in accordance with the requirements of §265.90 et seq. of these regulations. As part of §265.92(a), an owner or operator must develop a ground-water sampling and analysis plan. The simplest way to describe in the closure plan the monitoring required during closure is to include a copy of the sampling and analysis plan. However, since the ground-water monitoring program required under §265.90 will not be implemented until one year after the effective date of these regulations, the sampling and analysis plan may not be available at the time the closure and, if applicable, post-closure plans are written. It is intended, therefore, that the owner or operator use his judgment in describing the kinds of monitoring required to comply with the ground-water regulations. The Agency will be developing guidance for the preparation of these monitoring programs, and the owner or operator will gain operating experience about the monitoring needs of his facility once the program is implemented. Therefore, it is expected that the owner or operator will revise his plans as more guidance and data on ground-water monitoring become available. A copy of the ground-water sampling and analysis plan should be included in the closure plan when it becomes available.

2.2.8 Closure Certification

There are two certification requirements: (1) the owner's or operator's personal certification that closure has been done in accordance with the approved closure plan; and (2) an independent professional engineer's certification that closure has been done, to the best of his knowledge, in accordance with the approved closure plan. The engineer's certification does not guarantee the adequacy of the closure procedures and does not necessarily involve detailed testing and analysis; rather, it implies that, based on periodic facility inspections, closure has been completed in accordance with the specifications in the approved closure plan. The professional engineer's certification applies to the entire facility including those portions which were partially closed. Since it is difficult for a professional engineer to certify closure unless he has made inspections while the area is being closed, the owner or operator should consider having each partial closure certified as it is closed.

The professional engineer's certification is the final step of the technical closure requirements and signals the beginning of the post-closure care period, if the facility is a disposal facility. The certification does not guarantee the adequacy of closure itself nor does it relieve the owner or operator of future responsibility for the closure procedures. For example, if the Regional Office inspects the facility after closure has been certified and finds that closure is inadequate or has not been performed in accordance with the plan, the owner or operator is responsible for making necessary changes. This certification also does not terminate the closure financial responsibility requirements. The final date of closure, for purposes of financial responsibility requirements, is the date that the Regional Administrator releases the closure fund to the owner or operator.

2.3 BASIC RULES FOR DEVELOPING POST-CLOSURE PLANS

Owners or operators of disposal facilities, i.e., facilities at which wastes remain after closure, are required to have post-closure plans describing the activities to be performed after facility operations have ceased and the facility has been closed. Disposal facilities include landfills, and surface impoundments and land treatment facilities in which wastes remain after closure. The post-closure care period begins on the date that the professional engineer certifies that closure has been performed in accordance with the approved closure plan and ends 30 years thereafter unless the Regional Administrator specifies a different time period based on cause.

The purpose of the post-closure plan is to ensure that the owner or operator has adequately prepared for post-closure monitoring and maintenance, and security if necessary. The post-closure plan will contain descriptions of those activities to be performed during the 30-year period, given the site-specific conditions. The Agency has not stipulated specific technical requirements for post-closure care because of the wide variances among facility conditions.

Although all disposal facilities will have site-specific post-closure plans, all will include at least:

(1) A description of ground-water monitoring activities and frequencies; and
(2) Maintenance activities and frequencies to ensure the integrity of the cap and final cover or other containment structures and monitoring systems, as specified in the regulations for each type of facility.

A post-closure plan, developed in accordance with the objectives stated above, must include certain kinds of activities which are applicable to all types of disposal facilities. The purpose of this section is to clarify what is intended by these requirements.

2.3.1 Area of the Facility Included in the Post-Closure Plan

The post-closure plan should provide for post-closure care for the entire facility as it is expected to exist at the time of final closure. For example, if a 180-acre landfill facility is expected to be filled at a rate of 10 acres per year during its 18 years of operational life, the post-closure plan must reflect the post-closure activities to be performed for the full 180 acres. It should be noted that post-closure care only applies to those portions of the facility which are considered "active" on or after the effective date of these regulations.

2.3.2 Ground-water Monitoring

Hazardous waste disposal facilities are required to conduct ground-water monitoring operations during the post-closure period. The monitoring operations conducted during the active operation of the facility are expected to continue during post-closure. As discussed above, the discussion of monitoring in the plan will likely be revised after the ground-water monitoring program is implemented a year after the effective date of these regulations.

2.3.3 Maintenance of Waste Containment and Monitoring Systems

During the post-closure care period, the majority of the routine maintenance operations are directed at maintaining the integrity of the waste containment system and ensuring that the monitoring systems remain functional throughout the post-closure care period. These maintenance activities which must be described in the post-closure plan include both those required annually (e.g., monitoring, mowing, inspections) and those required on a periodic basis (e.g., replacing wells, replanting). The post-closure plan must include the types of activities required and their frequencies to enable the Regional Office to evaluate the plan and, when applicable, the post-closure care performance. If an owner or operator is not familiar with certain post-closure care activities, he may need to rely on his judgment and revise the plan when more information or operating experience becomes available.

2.3.4 Kinds of Maintenance to be Included in the Post-Closure Plan

The post-closure plan should include provisions for the kinds of maintenance activities that can reasonably be expected to be needed within the post-closure care period. These events may result from either natural phenomena or from accidental consequences of human activities. Natural events such as storms, droughts, seismic activity or subsidence should be considered "expected occurrences" if they could be expected to occur within 30 years, and the maintenance program should account for them. Similarly, over a period of 30 years, an owner or operator will likely be required to either replace or repair parts of the ground-water monitoring system. The owner's or operator's operating experience, combined with historical records of the area, can provide a reasonable estimate of expected future conditions and needs. For example, an owner or operator may be able to base his estimate of the rate of replacement of wells during post-closure on the replacement rate during operation; maintenance required to repair damage from storms can also be predicted on the basis of personal experience and historical records. Although an owner or operator may have little experience when he originally prepares his plan, when more data become available (e.g., operating experience, engineering manuals, EPA guidance), he may amend his original estimates.

Trying to predict future accidental contingencies, such as off-the-road vehicles being driven across the cover during a period of wet weather, vandalism, or inappropriate use of land, is more difficult, but some provision might be appropriate depending on the location of the facility and past experience. The post-closure plan is not meant to include extraordinary contingencies such as a total liner failure caused by a major earthquake. Such a catastrophic disaster is largely unpredictable, and an event of such low probability should not be included as a "routine" activity.

2.3.5 Cover Maintenance in the Early Post-Closure Years

During the early years of post-closure, a more extensive cover maintenance program may be required for two reasons:

- To repair damages to the cover caused by settling; and
- To replant areas of the cover that did not become established during the closure period.

Since in many cases much of the settling of the cover occurs in the initial years after its placement, portions of the facility that were covered during the closure period may require some reworking. If vegetation is used, it will also be necessary to include provisions during the early years of post-closure for replanting of areas of the cover that did not become established during the closure period. This is important to include in the post-closure plan because the owner or operator is only expected to plant vegetation once during closure and does not need to ensure that it becomes established.

2.4 DOCUMENTATION

Although written closure and post-closure plans are required, the regulations do not specify the format or documentation necessary. As a result, the Regional Administrator will have discretion over ultimate requirements. However, certain kinds of general guidance might be appropriate. The plan must be sufficiently detailed to achieve the following purposes:

(1) Provide for reasonable review to ensure that the conditions assumed in the plan adequately reflect the true conditions of the facility.

(2) Contain sufficient detail to permit a cost estimate of the kind described in Subpart H. Such a cost estimate will not require engineering drawings, but will require adequate descriptions of the methods, materials, and magnitudes of all significant activities.

(3) Provide assurance that the methods and materials employed will be able to carry out their intended purposes.

2.5 PLAN REVISIONS

In order to ensure that the activities described in the closure and post-closure care plans are appropriate, given the conditions of the facility at a given time, the plans must be revised whenever changes in operating plans or facility design affect the plans. The closure and post-closure plans must always include provisions for the most extensive activities that may be required under normal operating conditions. Since this requires the owner or operator to accurately predict uncertain future conditions, revisions to the plans will likely be necessary when unexpected conditions or changes in facility design become evident. A discussion of revising the closure and post-closure plans is included in Section 11.0.

2.6 PLAN EVALUATION

Faced with the range of site-specific variables and the host of technical alternatives for satisfying the requirements of the regulations, the EPA has opted for determining specific technical measures on a case-by-case basis. Given the site-specificity of the requirements, evaluating the adequacy of the closure and post-closure plans is critical for ensuring environmental protection. No single engineering study can address or provide a comprehensive guide to all of the variables involved in this problem.

This leaves the Regional Administrator with a critical role in evaluating technical procedures in approving closure plans. The Regional Administrator should therefore base his evaluation on engineering studies that do exist: EPA guidance documents, to the extent the data are applicable; information from the facility owner's or operator's experience and operating records; data relevant to the facility location that could affect environmental conditions (e.g., climate, hydrology, land use, water quality); and suggestions from regional engineering personnel.

3.0 TANKS: GUIDANCE FOR DEVELOPING CLOSURE PLANS

3.1 INTRODUCTION

The following material provides guidance for the EPA Regional Offices and the regulated community concerning the preparation of closure plans. The instructions are followed by a sample closure plan outline which illustrates the concepts and intentions of the plan. The discussion of closure plans provided in this document is based on the assumption that the facility has been operating properly and that no special requirements will be necessary to ensure adequate closure. The purpose of this document is not to provide guidance for remedial measures but rather to provide guidance to owners or operators of well-operated facilities. The instructions and the closure plan outline in this section are separated into the following major headings which, in most cases, correspond with the closure regulations applicable to tanks:

- Removing Inventory
- Decontaminating the Facility
- Closure Certification
- Summary of Facility Conditions

According to the regulations, a tank is defined as "a stationary device designed to contain an accumulation of hazardous waste which is constructed primarily of non-earthen materials (e.g., wood, concrete, steel, plastic) which provide structural support."* Since tanks are considered instruments of storage or treatment, they are normally found as part of a larger hazardous waste facility, rather than as single storage sites. At a multiple process facility composed of an incinerator and several tanks, an owner or operator may choose to prepare individual closure plans for tanks or incorporate them into the incinerator closure plan. It is left to the owner's or operator's discretion to decide which is the more appropriate approach. Guidance for preparing a closure plan for such multiple process facilities is briefly discussed in Section 8.0.

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*EPA Interim Status Standards, 40 CFR §260.10(a)(68).

3.2 FACILITY CONDITIONS

The primary purpose of this portion of the closure plan is to provide the Regional Offices with the information for an initial check of the adequacy of the closure plan. This section of the plan includes a description of the factors determining the condition of the facility; that is, a description of the facility (including storage equipment size and capacity), a description of equipment, a characterization of the wastes currently stored, the maximum amount of inventory ever on-site during operations, and a complete schedule of closure activities. With this information readily available, an inspector can quickly evaluate the closure plan using a visual inspection to confirm that facility conditions never exceed the specifications described in the first part of the closure plan.

3.2.1 General Information

General information that would be useful in a closure plan includes:

- Facility size;
- Storage facility descriptions;
- Other facilities on-site (e.g. landfill, incinerator, surface impoundment, etc.); and
- Waste characterization.

3.2.2 Maximum Inventory

The owner or operator must include in the closure plan "an estimate of the maximum inventory of wastes in storage or in treatment at any given time during the life of the facility."* This estimate of the maximum amount of inventory ever expected over the life of the facility should enable an inspector to evaluate quickly this portion of the plan based on a visual inspection of the facility.

3.2.3 Equipment and Facilities

The owner or operator should list and describe in the closure plan the kinds of equipment and facilities on-site to enable an inspector to evaluate quickly the proposed plans for facility decontamination.

3.2.4 Schedule of Activities

The closure plan must include "a schedule for final closure which must include, as a minimum, the anticipated date when wastes will no longer be received, the date when completion of final closure is anticipated, and intervening milestone dates which will allow tracking of the progress of closure. (For example, the expected date for completing treatment or disposal of waste inventory must be included, as must the planned date for removing any residual wastes from storage facilities and treatment processes.)"**

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*EPA Interim Status Standards, 40 CFR §265.112(a)(2).

**EPA Interim Status Standards, 40 CFR §265.112(a)(4).

The closure period begins with the final acceptance of waste and concludes when closure has been certified by a professional engineer.* The schedule of closure activities for a tank facility should include:

- Final date for accepting wastes;
- Final date for all processing and treatment;
- Final date for treatment, disposal or removal of inventory;
- Final date facility decontaminated;
- Final date closure completed, which is the date that closure has been certified by the professional engineer;
- The total time required to close the facility; and
- Justification if closure will take longer than six months from the date of the final acceptance of wastes (§265.113(b)). If an owner or operator requires more than six months to close the facility, the closure plan must include a justification for the need for additional time as well as proof that all steps have been taken to eliminate any significant threat to human health and the environment. A further discussion of closure schedules is in Section 2.2.6.

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*The final date of closure referred to here is the date that the closure technical requirements have been certified by the professional engineer. The final date of closure for purposes of the financial responsibility requirements is the date that the Regional Administrator releases the closure fund to the owner or operator. A discussion of the legal implications of closure certification is in Section 2.2.8.

3.3 REMOVING INVENTORY

An owner or operator must include in the closure plan:

- An estimate of the maximum amount of inventory reasonably expected on-site over the life of the facility;
- Procedures for any necessary pretreatment;
- Methods and procedures for treating, disposing or removing inventory, including all residues from processing; and
- Time schedule.

3.3.1 Maximum Amount of Inventory

The closure plan must include "an estimate of the maximum inventory of wastes in storage or in treatment at any given time during the life of the facility."* Inventory includes all wastes in all stages of processing, including wastes in the tanks, in storage, and residues from processing.

It should be noted that the concept of inventory may be somewhat misleading in the case of tanks, because a hazardous waste facility would rarely have tanks to the exclusion of all other forms of storage, treatment or disposal. Tanks, in fact, are most frequently found in combination with another type of facility; the wastes contained in tanks represent a portion of a facility's inventory. In the case of a facility providing only storage and/or treatment services, the inventory would include all wastes in the tanks and in other forms of storage (e.g., waste piles, drainage pits). A tank storage/treatment facility will probably have additional inventory stored in drums or similar containers. Such inventory should also be considered in determining an estimate of the "maximum amount ever on-site." If an owner or operator of a multiple process facility prepares a separate closure plan for the tanks at the facility, he should be careful not to double count his inventory. The tank's contents and any inventory in other forms of storage directly associated with the tank (e.g., wastes requiring storage and/or treatment in the tank) should be included in the estimate of the tank's maximum inventory.

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*EPA Interim Status Standards, 40 CFR §265.112(a)(2).

The estimate of inventory must be based on the maximum amount that would be on-site during the life of the facility. It should always be high enough to ensure that if an inspector came onto the facility, the amount of inventory would not exceed the estimate in the plan, assuming normal operating conditions.

Since accumulating inventory has often been the cause of severe environmental damage, requiring in the closure plan an estimate of the maximum inventory ever on-site alerts the Regional Office of a potential hazard if a visual inspection shows more wastes than the plan indicated. If the amount of inventory on-site ever exceeds the estimate in the plan, the owner or operator must revise the plan to reflect actual conditions; however, if the owner or operator can justify to the Regional Administrator that the excess inventory is a result of unexpected operating contingencies and the original estimate of maximum inventory can be restored quickly, the Regional Administrator might not require the owner or operator to revise the plan. A further discussion of maximum inventory is in Section 2.2.4.

3.3.2 Pretreatment

The closure plan must include a description of all processing and treatment of inventory necessary to prepare the contents of the tank or other storage facility for removal. Waste analyses and actual tests may be required if waste treatment processes not normally used will be necessary. The plan should also specify the quantity of wastes requiring pretreatment and the quantity resulting from pretreatment. The types of waste will affect the kinds of treatment required prior to disposal, as well as the methods for disposal (e.g., incompatible wastes may require special, or at least separate, modes of disposal).

3.3.3 Methods and Procedures for Treating or Disposing of Inventory

The procedures to be followed for treating or disposing of inventory are very site-specific and depend largely on whether or not on-site capacity is available and on the quantity of waste to be treated or disposed. Since tanks are frequently found as part of a treatment or disposal facility, it may be possible simply to manage all inventory on-site. In such a situation, on-site treatment or disposal is clearly the most convenient and least expensive method of managing the inventory because it involves, at most, only a short haul and requires only that the owner or operator follow normal operating procedures. If an owner or operator disposes of inventory on-site in a landfill which is permitted or has interim status, he must also provide for post-closure care for the landfill. If, however, there is not a treatment or disposal facility on-site, it will be necessary to remove all wastes to an off-site TSDF. The closure plan will include a description of the procedures necessary to complete the following activities:

- Operating the facility in a routine manner for the complete treatment or disposal of all inventory if inventory is to be treated or disposed on-site, including all stages of waste processing and treatment;
- Treating and disposing of wastes on-site in a different manner than routinely practiced during operation; and
- Removing and transporting all inventory for which on-site treatment or disposal is not feasible to an operating permitted hazardous waste facility or one operating under interim status.

On-Site Treatment or Disposal

If inventory is treated or disposed on-site, the closure plan must include an estimate of the amount of waste to be treated or disposed on-site, taking into account all residues from processing, if applicable. The plan will be based on the owner's or operator's estimate of the maximum number of drums and the maximum quantity of bulk waste and residues on hand at any time. The plan will contain a discussion of the kinds of activities necessary to operate the facility in a routine manner for the complete disposal of all inventory to be disposed on-site. The type and quantity of wastes in the tanks will greatly affect the procedures followed. The type of waste will affect the kind of pretreatment required prior to disposal. The quantity of waste will determine whether the owner or operator will have sufficient capacity if there is a permitted landfill or one with interim status on-site. If the landfill is part of the multiple process facility, the owner or operator should refer to the closure plan of the landfill.

Removing Inventory Off-Site

It is possible that, in some cases, off-site removal of inventory will be required. For example, if the tanks are simply part of a storage and treatment facility, if there is not available capacity at the landfill on-site, or if operating problems make on-site treatment or disposal impossible, all wastes would need to be transported and disposed off-site. If an owner or operator plans to dispose of some wastes off-site, he should include in the plan the quantity to be removed, a description of any treatment performed prior to transport, final treated disposal method, and an estimate of the distance to the final TSDF, to ensure that a facility will likely be available to accept the wastes.

3.3.4 Time Schedule

Accumulating inventory over long periods of time has often been the cause of serious environmental damages; thus, the regulations restrict the amount of time allotted during closure for treating, disposing or removing all wastes:

> "Within 90 days after receiving the final volume of hazardous wastes, the owner or operator must treat all hazardous wastes in storage or in treatment, or remove them from the site, or dispose of them on-site, in accordance with the approved closure plan."*

The owner or operator should state in the plan the procedures to be used for treating, disposing, or removing all inventory within 90 days. This ensures that an owner or operator must always have either the capacity available to treat or dispose of wastes quickly on-site or have made plans to remove inventory off-site.

3.4 DECONTAMINATING THE FACILITY

The closure plan must include "a description of the steps needed to decontaminate facility equipment during closure."** According to the regulations, "At closure all hazardous waste and hazardous waste residues must be removed from tanks, discharge control equipment, and discharge confinement structures."*** The plan should include a description of the cleaning, testing and/or disposing of all items so that no hazardous materials remain on-site. This will include cleaning up or disposing of contaminated equipment, soils and residues. The degree of cleanup required at a given facility at the time of final closure will vary according to the owner's or operator's operating practices.

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*EPA Interim Status Standards, 40 CFR §265.113(a).

**EPA Interim Status Standards, 40 CFR §265.112(a)(3).

***EPA Interim Status Standards, 40 CFR §265.114.

3.4.1 Decontaminating the Soil

The closure plan will include a list of all areas with potentially contaminated soil requiring removal and disposal, and include a description of disposal methods. Residues will be likely on the surrounding grounds as a result of drips and spills or storage (e.g., residues on drainage pits, spill containment areas). Soil testing may or may not be necessary depending on the facility conditions; the owner or operator should state in the plan the criteria used to determine the amount of contaminated soil to be removed and disposed. An owner or operator will need to refer to Section 261 of these regulations, "Identification and Listing of Hazardous Wastes," for the criteria for identifying the characteristics of hazardous wastes.

The amount of contaminated soil which must be removed and disposed will be a major factor in determining whether disposal will be on- or off-site. For example, if the tank is part of a multiple process facility which has permitted land disposal facilities or ones with interim status, the soil may be disposed on-site. If the tank is part of a facility without land disposal capabilities (e.g., an incinerator facility), plans for off-site disposal will also be necessary since most incinerators are not able to handle large quantities of contaminated soil.

3.4.2 Decontaminating the Equipment and Facility

The closure plan should describe the procedures used to decontaminate or dispose of the following:

- Tanks and other storage areas;
- All equipment used prior to storage/treatment in a tank, such as waste feed systems, by-pass systems, drainage systems, conveyors, containers used for transport;
- Discharge confinement structures (e.g., dikes);
- Piping, pumps, valves;
- Cleaning equipment; and
- Cleaning wastes and residues from cleaning.

The owner or operator must include in the closure plan a description of procedures for cleaning all equipment and facilities, an estimate of the amount of residues resulting from cleaning (e.g., residues from the cleaning process, hazardous cleaning fluids, wastewaters, containers, etc.) and plans for disposal. As discussed above, these residues may be disposed on-site if there is an available permitted disposal area or one with interim status as part of the multiple process facility, or they may be disposed off-site.

3.5 CLOSURE CERTIFICATION

"When closure is completed, the owner or operator must submit to the Regional Administrator certification both by the owner or operator and by an independent registered professional engineer that the facility has been closed in accordance with the specifications in the approved closure plan."*

An independent professional engineer is required to certify that closure activities were performed in accordance with the approved closure plan. It is not expected that an engineer will perform detailed tests. The owner or operator will include an estimate of the number of periodic inspections to be made by an engineer in the closure plan. The closure plan need not include the name and the state professional engineer license number of the engineer although this might be required later as documentation.

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*EPA Interim Status Standards, 40 CFR §265.115.

3.6 SAMPLE CLOSURE PLAN OUTLINE: TANKS

EPA Facility I.D. No.______________________________

Owner's or Operator's Name______________________________

Address & Phone No.______________________________

Facility Address______________________________

I. FACILITY CONDITIONS

- A. General information
  - 1. Size of facility
  - 2. Number of tanks
  - 3. Storage facilities
    - a. Type (e.g., bulk or drums)
    - b. Capacity/volume
  - 4. Other facilities on-site
    - a. Type (landfill, incinerator, basin, etc.)
    - b. Volume/capacity
  - 5. Waste characterization (to be filled out for each type of waste in inventory [e.g., phenolic wastewater, scrubber sludge, etc.], including waste material at any stage of processing, and/or any residue generated by the normal processing of the waste before or during closure, including contaminated soil or containers).*
    - a. Chemical composition.
    - b. Physical state (i.e., liquid, solid, gas or mixture)

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*NOTE: The Interim Status Standards require that "unless the owner or operator can demonstrate...that any solid waste removed from his tank is not a hazardous waste, the owner or operator becomes a generator of hazardous waste and must manage it in accordance with all applicable requirements of Parts 262, 263, and 265 of this Chapter" (§265.197) (emphasis added).

        - c. Combustion temperature
        - d. Specific gravity of the waste
    - 3. Maximum amount of inventory ever on-site in any stage of processing
- C. Inventory of auxiliary equipment
- D. Schedule of final closure (milestone chart)
    - 1. Final date wastes accepted
    - 2. Dates for completion of inventory disposal
        - a. Date all preprocessing completed
        - b. Date all on-site disposal completed
        - c. Date that all inventory has been disposed on-site
        - d. Date that all inventory has been removed off-site
    - 3. Final date facility decontaminated
    - 4. Final date closure completed
    - 5. Total time required to close the facility
    - 6. Justification if closure is longer than six months

II. REMOVING ALL INVENTORY (to be filled out for each type of waste in inventory, including waste material at any stage of processing, and/or any residue generated by the normal processing of the waste before or during closure)*

- A. Maximum amount of waste on-site in any stage of processing
    - 1. Total amount of waste/residue in drums and number of drums, if applicable
    - 2. Total amount of waste/residue in tanks and number of tanks (include tag number or other means of identification for each tank)

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*NOTE: The Interim Status Standards note that "unless the owner or operator can demonstrate...that any solid waste removed from his tank is not a hazardous waste, the owner or operator becomes a generator of hazardous waste and must manage it in accordance with all applicable requirements of Parts 262, 263, and 265 of this Chapter" (§265.197) (emphasis added).

    3. Total amount of waste/residue in other forms of storage, if applicable (e.g., waste piles, basins, drainage pits, etc.)

  B. Pretreatment
    1. Quantity requiring pretreatment
    2. Pretreatment process (including any equipment or materials needed)
    3. Total amount to be treated or disposed following pretreatment
  C. Methods and procedures for treating, disposing, or removing inventory
    1. Procedures for on-site inventory treatment or disposal
      a. Quantity
      b. Method of treatment or disposal
      c. Size of area, capacity or number of trenches necessary for inventory treatment or disposal
    2. Procedures for off-site removal of inventory
      a. Quantity
      b. Method of treatment or disposal
      c. Approximate distance to off-site TSDF

III. DECONTAMINATING THE FACILITY
  A. Area of facility with potential soil contamination (sq. yd.)
    1. List areas with potential contaminated soil
      a. Number of soil samples, if necessary
      b. Criteria for determining contamination
    2. Estimated depth of soil requiring removal
    3. Total amount of contaminated soil (cu. yd.)
      a. Amount of contaminated soil disposed on-site
      b. Amount of contaminated soil removed off-site
  B. All equipment and/or facilities requiring cleaning (e.g., tanks, surface impoundments, drainage pits, discharge control equipment, tank trucks)

1. Describe each piece of equipment and/or storage facilities and procedures for cleaning (e.g., steam-cleaning, hydro-blasting, etc.)
   a. Owner or operator labor or contractor
   b. Quantity of residues from cleaning
2. Treatment or disposal method for residues from decontamination (including wastewater and liquid wastes)
   a. Quantity treated or disposed on-site and method of treatment or disposal
   b. Quantity sent off-site, method of treatment or disposal, and approximate distance to TSDF

IV. CLOSURE CERTIFICATION

A. A schedule or estimate of the number of periodic inspections by the certifying engineer anticipated during closure.

4.0 SURFACE IMPOUNDMENTS:
GUIDANCE FOR DEVELOPING CLOSURE PLANS

The following material provides instructions for the EPA Regional Offices and the regulated community concerning the preparation of closure plans. The instructions are followed by a sample closure plan outline which illustrates the concepts and intentions of the plan. This document and the accompanying outline are intended merely as guidance and many parts of them may not be applicable to any given facility. This guidance is based on the assumption that the surface impoundment has been operating properly and that no special requirements will be necessary to ensure adequate closure. The purpose of this document is not to provide guidance for remedial measures but rather to provide assistance to owners or operators of well-operated facilities in developing closure plans. A general discussion of conceivable problems that might exist at some facilities and the kinds of measures that might be needed is included in Section 9.0, "Closure and Post-Closure Activities Required at Some Disposal Facilities."

The instructions and the outline are separated into two categories: (1) surface impoundments in which wastes remain in the impoundment after closure; and (2) surface impoundments in which wastes are removed from the impoundment at closure. An owner or operator of a surface impoundment which is a disposal facility, i.e., a facility in which wastes remain in the impoundment after closure, "must close the impoundment and provide post-closure care as for a landfill under Subpart G and §265.310."* If an owner or operator removes standing liquids, hazardous wastes, residues, the liner, and underlying and surrounding contaminated soil from the impoundment at closure, or can show that use of these remaining are hazardous wastes then "the impoundment is not further subject to the requirements of this Part."* It should be noted that these regulations only require removal of hazardous wastes; therefore, an owner or operator who removes all hazardous materials is in compliance with these regulations but may need to perform other activities to comply with other regulations (e.g., zoning ordinances, solid waste regulations, etc.).

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*EPA Interim Status Standards, 40 CFR §265.228(c).

Since these regulations only require that hazardous wastes be removed, an owner or operator has the third option of preparing a plan based on the assumption that no hazardous wastes remain in the impoundment at closure. For example, if an owner or operator is treating hazardous organic chemicals, it is possible that, assuming treatment is successful, there will be no hazardous wastes remaining at closure. In this case, closure activities would include the completion of treatment operations, tests proving that no hazardous wastes remain in the impoundment, and necessary facility decontamination. An owner or operator must have sufficient evidence to demonstrate that the facility's treatment processes render all wastes non-hazardous and that he is justified in preparing a closure plan based on this assumption.

When developing the closure plan, an owner or operator assumes that he will: close the impoundment as a disposal facility, with the additional post-closure responsibilities; remove all hazardous wastes from the impoundment and eliminate the need for post-closure care; or provide test results demonstrating that no hazardous constituents remain in the impoundment at closure. It is possible that an owner or operator will remove wastes from the impoundment and place them in a separate landfill on-site if one is operating with interim status or a permit; in this case, the owner or operator must prepare a closure plan for the impoundment and closure and post-closure plans for the landfill. An owner or operator may also transfer all wastes into one section of the impoundment at closure. In this case, the closure plan should distinguish between the area from which all wastes have been removed and the area in which wastes remain which will be closed like a disposal facility, i.e., a facility in which wastes remain at closure.

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*EPA Interim Status Standards, 40 CFR §265.228(b).

In preparing the closure and, if applicable, post-closure plan, the owner or operator must address how the facility will be closed "in a manner that (a) minimizes the need for further maintenance, and (b) controls, minimizes or eliminates, to the extent necessary to protect human health and the environment, post-closure escape of hazardous waste, hazardous waste constituents, leachate, contaminated rainfall, or waste decomposition products to the ground water, or surface waters, or to the atmosphere."* The terms "human health," "environment" and "control" are all relative terms. In some cases, protection of human health and environment may mean no discharge, while, in other cases, some escape may be acceptable. To meet these objectives, the owner or operator must develop as part of his closure and post-closure plan an adequate analysis of the effectiveness of the proposed closure and post-closure procedures.

4.1 SURFACE IMPOUNDMENTS IN WHICH WASTES REMAIN AT CLOSURE

A surface impoundment in which wastes remain at closure is considered a disposal facility. A disposal facility is defined as "a facility or part of a facility at which hazardous waste is intentionally placed into or on any land or water, and at which waste will remain after closure."**

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*EPA Interim Status Standards, 40 CFR §265.112(a).

**EPA Interim Status Standards, 40 CFR §260.10(a)(15).

If the owner or operator does not remove all hazardous materials from the impoundment at closure, "he must close the impoundment and provide post-closure care as for a landfill under Subpart G and §265.310. If necessary to support the final cover specified in the approved closure plan, the owner or operator must treat remaining liquids, residues, and soils by removal of liquids, drying, or other means."* This requirement only applies to hazardous wastes; if tests show that all or part of the wastes have been rendered non-hazardous, those non-hazardous wastes need not be removed.

4.1.1 Introduction

The instructions and the outline are separated into the following major headings which correspond with the regulations applicable to impoundments in which wastes remain at closure. The closure plan should include a general description of facility conditions and must include descriptions of the activities required to comply with the following closure requirements:

- Removing Inventory
- Removing Standing Liquids
- Decontaminating the Facility
- Cover and Vegetation
- Ground-water Monitoring
- Closure Certification

4.1.2 Facility Conditions

The primary purpose of this portion of the closure plan is to provide the Regional Office with the information for an initial check of the adequacy of the closure plan. This section of the plan contains a description of the factors determining the conditions of the facility, including the capacity of the impoundment, the maximum amount of inventory expected to accumulate on-site during operations, a description of equipment and facilities, and a complete schedule of closure activities. With this information readily available, an EPA inspector can quickly evaluate the closure plan using a visual inspection to confirm that facility conditions never exceed the specifications described in the first part of the closure plan.

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*EPA Interim Status Standards, 40 CFR §265.228(c).

General Information

General information that would be useful in a closure plan includes:

- Facility size;
- Volume of impoundment;
- Type of treatment;
- Copy of NPDES permit, if the impoundment discharges through a point source to U.S. waters; and
- Procedures and schedules for dredging during operation, if applicable.

It is likely that during the course of normal operations, the impoundment will be dredged. The closure plan should provide a schedule for these periodic dredgings which may include:

- Volume of waste dredged;
- Frequency of dredging;
- Procedures for dredging; and
- Method of disposing of dredged material.

Partial Closure

An owner or operator may partially close the impoundment during facility operations by diking off areas that are no longer to be used, and properly closing those areas. Partial closure includes those activities that reduce what needs to done at final closure to comply with the regulations. The closure plan must include plans to close the largest area of the impoundment that will be open at any given time. If an owner or operator intends to partially close the impoundment, the closure plan must include "a description of how and when the facility will be partially closed, if applicable, and ultimately closed."* The closure plan must provide a schedule of these activities and a description of:

- The size of the area partially closed;
- Frequency of these partial closures; and
- Proposed methods for partial closures (i.e., removal of all wastes or cover for buried wastes), including, if applicable, type and source of cover and maintenance program.

An owner or operator may partially close an impoundment in one of two ways: sections may be diked off and all hazardous wastes may be removed; or the wastes may be retained in the diked off area and the area closed in compliance with the landfill disposal requirements. If no hazardous wastes remain in these areas, no further activities are required at closure. If the area is filled and covered, the closure plan must describe how these areas will be closed and maintained to prevent water infiltration and runoff, to prevent soil and wind erosion, to mitigate subsidence problems, and to ensure that these areas are in good condition at final closure. A discussion of the kinds of maintenance activities required for disposal areas that have been partially closed (e.g., inspections, monitoring, routine maintenance) is included in Section 6.3, "Maintenance of Partially Closed Areas."

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*EPA Interim Status Standards, 40 CFR §265.112(a)(1).

The key factor about partial closure which must be made clear in the closure plan is that partial closure procedures (i.e., activities which reduce the requirements at final closure) must be in accordance with the technical closure requirements and consistent with the plans for final closure. For example, if an owner or operator dikes off a portion of the impoundment and covers it with an inadequate cap which will either require reworking or replacement at the time of final closure, this area cannot be considered partially closed. Similarly, if the activities stipulated for final closure include a cap with 2 feet of clay with a permeability of 10^{-7} cm/sec and 2 more feet of a more permeable material, these specifications must apply to all portions of the facility which have a cover, including areas that have been partially closed.

Maximum Amount of Waste

The owner or operator must include in the closure plan "an estimate of the maximum inventory of wastes in storage or in treatment at any given time during the life of the facility."* This estimate of the maximum amount of inventory ever expected over the life of the facility enables an inspector to evaluate this portion of the plan based on a visual inspection of the facility.

Equipment and Facilities

The owner or operator should describe the kinds of equipment and facilities on-site (e.g., transport vehicles, excavation equipment, spreaders, etc.) to enable an inspector to quickly evaluate the proposed plans for decontaminating the facility.

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*EPA Interim Status Standards, 40 CFR §265.112(a)(2).

Schedule of Final Closure

The closure plan must include "a schedule for final closure which must include, as a minimum, the anticipated date when wastes will no longer be received, the date when completion of final closure is anticipated, and intervening milestone dates which will allow tracking of the progress of closure. (For example, the expected date for completing treatment or disposal of waste inventory must be included, as must the planned date for removing any residual wastes from storage facilities and treatment processes.)"*

The closure period begins with the final acceptance of waste and concludes when closure has been certified by the professional engineer.** The schedule of closure activities applicable to surface impoundments in which wastes remain at closure should include:

- Final date for accepting wastes;
- Date all treatment completed;
- Date that all standing liquids will have been removed;
- Final date facility decontaminated;
- Date final cover completed (this date is largely affected by the size of the area to be covered and climatic conditions which may halt construction activities);

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*EPA Interim Status Standards, 40 CFR §265.112(a)(4).

**The final date of closure referred to here is the date that the closure technical requirements have been certified by the professional engineer. The final date of closure for purposes of financial responsibility requirements is the date that the Regional Administrator releases the closure fund to the owner or operator. A discussion of the legal implications of closure certification is in Section 2.2.8.

- Final date vegetation planted or material used to control erosion placed; the date to be listed here is the date that planting has been completed, if vegetation is used;
- Final date of closure and the effective date of post-closure, which is the date that closure has been certified by the professional engineer;
- Total time required to close the facility, i.e., time from the final acceptance of waste to certification by the professional engineer; and
- Justification if closure will take longer than six months from the date of the final acceptance of wastes (§265.113(b)). If an owner or operator requires more than six months to complete closure, the closure plan must include a justification for the need for additional time as well as proof that all steps have been taken to eliminate any significant threat to human health and the environment. A further discussion of closure schedules is in Section 2.2.6.

4.1.3 Removing Inventory

An owner or operator of an impoundment must include in the closure plan:

- An estimate of the maximum amount of inventory reasonably expected on-site over the life of the facility;
- Methods and procedures for treating, storing or removing all inventory, including processing residues; and
- Time schedule.

Maximum Inventory

The closure plan must include "an estimate of the maximum inventory of wastes in storage or in treatment at any given time during the life of the facility".* Inventory, in the case of impoundments in which wastes are to remain after closure, includes all wastes in all stages of processing, including storage, residues from processing, and standing liquids in the impoundment which must be removed.

The estimate of inventory must be based on the maximum amount ever expected to be on-site over the life of the facility, assuming normal conditions. It should always be high enough to ensure that if an inspector came onto the facility, the amount of wastes in storage as well as the amount of liquid in the impoundment would not exceed the estimate in the plan, assuming normal operating conditions.

Since accumulating inventory has often been the cause of severe environmental damage, an owner or operator should keep the amount of wastes in storage at a minimum. Requiring in the closure plan an estimate of the maximum amount of inventory also alerts the Regional Administrator to a potential hazard if a visual inspection of the facility shows more wastes than the plan indicated. If the amount of wastes on-site ever exceeds the estimate in the plan, the plan must be revised to reflect actual conditions; however, if the owner or operator can justify to the Regional Office that the excess inventory is a result of unexpected operating conditions and the original estimate of maximum inventory can be restored quickly, the Regional Administrator might not require the owner or operator to revise the plan. A further discussion of maximum inventory is in Section 2.2.4.

Methods and Procedures for Treating, Storing or Removing Inventory

The procedures to be followed are very site-specific and must be described in the closure plan. At a minimum, the owner or operator will describe procedures necessary to complete the following activities:

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*EPA Interim Status Standards, 40 CFR §265.112(a)(2).

- Operating the facility in a routine manner while treating and removing wastes in storage, including all standing liquids, if standing liquids are to be removed by evaporation or treatment and discharge;
- Stabilizing all sludge remaining in the impoundment;
- Removing and transporting liquids not removed by evaporation or treated and discharged on-site to an operating permitted facility or a facility operating under interim status; and
- Removing all hazardous wastes from sections of the impoundment which will not be disposal areas.

The closure plan should describe procedures to be used for treating all wastes in storage and removing all standing liquids. If wastes are to be discharged, the owner or operator must comply with the Clean Water Act. The plan should also include a discussion of proposed procedures for stabilizing the sludge (e.g., quantity and type of bulking agents used). An owner or operator may prefer to transfer some liquids to another facility because of operating problems or because treatment is taking longer than anticipated. In this case, the owner or operator should include an estimate of the amount disposed off-site and ensure that the receiving facility is either permitted or operating under interim status.

At the time of closure, an owner or operator may transfer all remaining sludge to one portion of the impoundment, dispose of it elsewhere on-site if he has a permitted landfill or one with interim status, or dispose of some of it off-site to reduce the size of the area that will require a final cover and post-closure care. If removing sludge is to be part of closure procedures, the plan should include the quantity of sludge to be removed and explain how it will be disposed. If it will be disposed in a permitted landfill on-site or one which has interim status, the owner or operator must have prepared closure and post-closure plans for the landfill. If some of the sludge is to be disposed off-site, the plan also should include an estimate of the distance to a permitted operating facility or one operating under interim status. If an owner or operator intends to only close a portion of the facility as a disposal facility, the remainder of the facility must be devoid of all hazardous materials.

Time Schedule

Accumulating inventory over long periods of time has often been the cause of serious environmental damage; thus, the regulations restrict the amount of time allotted during closure for treating, storing or removing all wastes:

> "Within 90 days after receiving the final volume of hazardous wastes, the owner or operator must treat all hazardous wastes in storage or in treatment, or remove them from the site, or dispose of them on-site, in accordance with the approved closure plan."*

The owner or operator of an impoundment should include an estimate of the time required for treatment. If treatment processes routinely take longer than 90 days, the plan should include a justification for this extension, subject to the Regional Administrator's approval.

4.1.4 Decontaminating the Facility

The closure plan must include "a description of the steps needed to decontaminate facility equipment during closure."** According to the regulations, "when closure is completed, all facility equipment and structures must have been properly disposed of, or decontaminated by removing all hazardous waste and residues."* The closure plan should include a description of the cleaning, testing and/or disposing of all items so that no hazardous materials remain undisposed on-site. This will include cleaning up or disposing of contaminated equipment, soils and residues. The degree of cleanup required at a given facility at the time of final closure will vary according to the owner's or operator's operating practices.

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*EPA Interim Status Standards, 40 CFR §265.113(a).

**EPA Interim Status Standards, 40 CFR §265.112(a)(3).

Decontaminating the Soil

The closure plan will include a list all areas with potentially contaminated soil requiring removal and disposal, an estimate of the quantity of contaminated soil to be disposed, and a description of disposal methods. Cleanup of hazardous waste drips and spills will be part of routine operating practices. The residues included in the closure plan are those on the surrounding grounds as a result of closure operations and those not previously cleaned up (e.g., residues on dikes, storage areas, trenches, diversions, spill containment areas). Soil testing may not be necessary depending on the facility conditions; the owner or operator should state in the plan the criteria used to determine the amount of contaminated soil to be disposed or removed to an off-site TSDF. An owner or operator will need to refer to Section 261 of these regulations, "Identification and Listing of Hazardous Wastes," for the criteria for identifying the characteristics of hazardous wastes.

The amount of contaminated soil which must be removed and disposed will be a major factor in determining whether it will be disposed of in the impoundment itself, on-site in a permitted landfill or one with interim status if part of a multiple process facility, or removed off-site to a TSDF. If space is not available in the impoundment, the closure plan must include plans for removing the soil off-site to a TSDF or disposing of it on-site in a landfill if the facility is a multiple process facility.

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*EPA Interim Status Standards, 40 CFR §265.114.

Decontaminating the Equipment and Facility

The closure plan may include a description of procedures used to decontaminate or dispose of the following:

- All transport and storage containers, tanks and ancillary facilities;
- All equipment, including that used for transport, storage, treatment, disposal, earth-moving, and cleaning processes;
- Cleaning wastes and residues from cleaning; and
- Any remaining water on-site from rain or snow.

The owner or operator must include in the closure plan a description of procedures for cleaning all equipment and facilities, an estimate of the amount of residues resulting from cleaning (e.g., residues from the cleaning process, cleaning fluids that are hazardous, wastewaters, containers), and plans for their disposal or removal to an off-site TSDF. For facilities at which it is common for water to accumulate as a result of rain or snow, the closure plan must provide for removing excess water at the time of closure.

It is likely that most, if not all, of these residues will be disposed of in the impoundment. An owner or operator may need to dispose of some wastes in a landfill on-site if the facility is a multiple process facility, or remove them to an off-site facility if the impoundment is already filled to capacity or cleaning residues are incompatible with the sludge in the impoundment. If the wastes are to be disposed in a cell on-site apart from the impoundment, the description of activities should include landfilling procedures and closure activities if a separate closure plan has not been prepared for the landfill.

4.1.3 Cover and Vegetation

An owner or operator of an impoundment which is a disposal facility, i.e., a facility in which wastes remain at closure, must close in accordance with the landfill closure regulations. If an owner or operator designates only a section of the impoundment as a waste repository, these landfill regulations apply only to that section of the facility.

According to the regulations, "in the closure and post-closure plan under §265.118, the owner or operator must address the following objectives and indicate how they will be achieved:

(1) Control of pollutant migration from the facility via ground water, surface water, and air;
(2) Control of surface water infiltration, including prevention of pooling; and
(3) Prevention of erosion."*

An owner or operator of a land disposal facility must demonstrate in the closure and post-closure plans that the post-closure escape of hazardous waste constituents to ground water, surface water or the atmosphere will be controlled in a manner so as not to pose a threat to human health and the environment. In addressing these objectives, the owner or operator must consider at a minimum the site location, topography and land use, climate, hydrogeological conditions, and characteristics of the proposed final cover. The closure plan should include a description of the natural or synthetic liner system, final cover, and vegetation. The type of cover and vegetation required will vary on a site-specific basis depending on what is necessary to protect human health and the environment. In some cases, this protection may mean that no discharge is acceptable from a particular facility, while in other cases, some escape could be acceptable. For example, the level of discharge acceptable from a facility located near a drinking water source would be significantly less than from a facility that only discharges into a completely nonpotable water source.

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*EPA Interim Status Standards, 40 CFR §265.310(a).

It is expected that most well-operated facilities will require, at a minimum, a final cover and vegetation, or other material to stabilize the cover, to ensure adequate control of the migration of wastes. A general discussion of other kinds of control technologies that might be needed to adequately close a facility is in Section 9.0, "Closure and Post-Closure of Disposal Facilities With Less than Optimum Control Technology."

Final Cover

The final cover refers to the materials and surface contours used to cover the impoundment at closure. In most cases, vegetation or some other material will be required to stabilize the final cover. The integrity of the final cover is an important closure requirement for an impoundment which is a disposal facility. The owner or operator must describe in the closure plan the type of cover (material and final surface contours) most appropriate at that facility, taking into account the functions of the cover (e.g., infiltration control, erosion and run-off control, wind erosion control, and prevention of ponding), and characteristics of the cover. The owner or operator will also need to demonstrate the adequacy of the particular cover chosen in meeting the objectives of the regulations, i.e., adequate containment or control of wastes. The description of final cover in the closure plan should include:

- The area of the facility that requires a final cover;
- Characteristics of cover (e.g., type of soil, thickness, permeability); and
- Cover design.

These site-specific specifications of the cover included in the closure plan also apply to all previous partial closures. A further discussion of partial closures is in Section 4.1.2.

- Area of the Impoundment Requiring Final Cover

An owner or operator must include in the closure plan an estimate of the maximum area of the facility that will require a final cover at closure and the size of the area from which all wastes will be removed. The size of the area requiring a final cover depends upon how much, if any, of the impoundment has been partially closed, the procedures used for partial closures, and plans for final closure. If all hazardous wastes were removed from sections of the impoundment and these areas were diked off as part of partial closures, these sections will not be disposal areas and will therefore not require a final cover; partially closed areas that were designated as disposal areas and were therefore not previously covered in accordance with landfill regulations may require extensive earthwork, depending on the extent to which these inactive areas were maintained. At final closure, an owner or operator may choose to designate one portion of an impoundment as a disposal area and transfer all of the wastes from the rest of the impoundment to that section. In this situation, the owner or operator would close part of the impoundment in accordance with the landfill regulations and the rest as a treatment facility (see Section 4.2).

- Characteristics of Cover

In describing the characteristics of the final cover, the closure plan should include:

- The type(s) of material(s) used for the cover (e.g., density, porosity, permeability, compatibility with waste to ensure wastes will not corrode cover);
- The thickness of each material chosen;
- Total amount of material required which is a function of the size of the area to be closed and depth of cover;
- Amount and type of soil additives, if applicable; and
- Source of materials.

It is likely that at most facilities the final cover will be of some impermeable material to protect against surface water infiltration. This impermeable material may be compacted clay (e.g., soil with a permeability of 10^{-7} cm/sec) or may be a barrier membrane liner over a buffer layer of soil, depending on soil availability and the site-specific conditions of the facility. If the final cover is to be planted with vegetation for purposes of erosion control, a top layer capable of supporting vegetation will be required. In arid regions of the country, gravel may be preferable to vegetation for controlling erosion.

The materials to be used will depend on the types of soil available on-site as well as the conditions of the facility. Since purchasing soil off-site is costly, it is most likely that most owners or operators will use soil available on-site, if at all possible, for the final cover, i.e., the layer with low permeability and the layer capable of supporting vegetation, if applicable. It is possible to improve the quality of available soil by blending various soils, using soil additives, or making other provisions which would provide equivalent protection. For example, soil blending and synthetic additives may decrease the permeability of the on-site soil as well as make certain soils more capable of supporting vegetation. In addition to improving the quality of available soil, the Agency anticipates that many owners or operators will use membrane liners protected above and below by buffer soil layers instead of compacted clay for the cover layer which should be low in permeability. These membrane liners may be cost effective if adequate material is unavailable or an acceptable degree of compaction is not possible at a particular facility, given the wastes disposed or facility conditions.

If the owner or operator intends to use soil available on-site for the final cover, he should state in the plan whether the soil has previously been excavated and stockpiled or whether excavation will be required at closure. The hauling distance of the soil should also be included. The plan will include an estimate of the quantity of materials to be purchased off-site, if applicable. If a membrane liner is to be used, the owner or operator should state the type of liner to be used and describe the sub-base preparation and the protective cover of the liner in the closure plan.

- Cover Design

The closure plan shall contain descriptions of the proposed grading and terracing for purposes of erosion control. The description will include:

- Slope of cover which must be great enough to prevent water pooling but not encourage erosion;
- Length of run of slope; and
- Drainage and diversion structures to channel water away from the waste area.

The owner or operator should also state whether a contractor or the owner or operator will do the earthwork activities and whether the necessary equipment is available on-site.

Vegetation

Most impoundments, or portions of impoundments that have been covered, will require good vegetation to stabilize slopes and retard runoff flow, thus providing effective erosion control. Other materials besides vegetation may be used for this purpose; for example, facilities located in very arid regions may use a gravel layer to stabilize the cover soil. In describing the vegetation to be used, the owner or operator should include in the closure plan:

- Surface area requiring vegetation or other stabilizing material;
- Characteristics of vegetation to be planted, if applicable;
- Soil preparation procedures, if applicable; and
- Description of methods or techniques for alternative stabilizing cover if vegetation will not be planted.

If vegetation is to be planted, the closure plan need only include provisions for planting once during the closure period. Any necessary replanting will be carried out during the early years of post-closure and will be discussed in the post-closure plan.

- Surface Area Requiring Vegetation or Other Stabilizing Material

The estimate of the area requiring vegetation or other stabilizing material at closure will be the maximum amount ever required during the life of the facility, and will include:

- Area of the impoundment requiring vegetation or other stabilizing material at final closure;
- Any portions of the impoundment that were capped as part of partial closure but were not vegetated, if applicable; and
- Areas that were previously vegetated but require some replanting.

- Characteristics of Vegetation

The type of vegetation chosen, assuming vegetation is used to prevent erosion, will vary according to the type of soil used for the final cover (e.g., depth, nutrients, pH, moisture), climate, amount of rainfall, and other site-specific factors. Information that would be helpful in the closure plan includes the type of vegetation chosen; climatic, soil, and maintenance requirements (e.g., temperature, rainfall, nutrients, pH, depth and moisture of soil, frequency of replanting, watering, fertilizing); and the depth of the root structure to ensure that the roots could not penetrate through the cover into the buried wastes.

- Soil Preparation Procedures

A description of soil preparation activities may include:

- Type and quantity of fertilizer required;
- Quantity of seed required;
- Type and quantity of mulch required; and
- Procedures for soil preparation (e.g., disking).

If an alternative to vegetation is to be used, the closure plan should include the type and quantity of materials to be used and an explanation of how it will protect the integrity of the cover.

The owner or operator should state whether or not a contractor will be responsible for planting the vegetation or an alternative cover. If planting vegetation has been part of prior partial closure procedures, much of this information will be known from operating experience.

4.1.6 Ground-water Monitoring

Ground-water monitoring "must be carried out during the active life of the facility, and for disposal facilities, during the post-closure care period as well."* Monitoring will be in accordance with the requirements specified in §265.90 et seq. of these regulations. A description of a monitoring program to be included in the closure plan would include:

- The types of analyses required during closure, i.e., from the date that final wastes are received until closure is certified by the professional engineer, assuming the manner and frequency as required during operation; and
- Maintenance that is required of the ground-water monitoring system to ensure that it is in working condition for the post-closure period.

The simplest way to describe the monitoring to be performed during closure is to include a copy of the facility's ground-water sampling and analysis program. Since this program will not be implemented until one year after the effective date of these regulations, the Agency will be developing guidance for preparing monitoring plans. This document is not intended to provide guidance in this area; therefore, it is expected that, in developing the closure plan, an owner or operator will use his judgment in describing appropriate ground-water monitoring as required by §265.90 et seq. and revise the plan when more data and guidance become available. The closure plan should include a copy of the facility's ground-water sampling and analysis program when it is available.

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*EPA Interim Status Standards, 40 CFR §265.90(b).

Analyses Required During Closure

According to the ground-water monitoring regulations, samples collected to establish ground-water quality must be obtained and analyzed for the following parameters at least annually:

- chloride
- iron
- manganese
- phenols
- sodium
- sulfate

Samples collected to indicate ground-water contamination must be obtained and analyzed for the following parameters at least semi-annually:

- pH
- specific conductance
- total organic carbon
- total organic halogen

The closure plan should include the maximum number and types of ground-water analyses required during the closure period. The number and types of sampling and analyses required during closure depend on the length of the closure period. For example, if one set of analyses are required annually and the others are required semi-annually, the owner or operator should allow in his plan for the possibility that both sets of analyses will be required within the closure period, in order to make provisions for the maximum number of analyses. For this reason the closure plan may include a schedule of more analyses than actually will be needed during closure.

Maintenance

The closure plan will also include a description of maintenance activities necessary to ensure that the ground-water monitoring system is in working condition for the post-closure period, which may include replacing or redrilling wells, replacing seals and caps, pumps, etc., and required general maintenance. Since ground-water monitoring during closure is merely a continuation of monitoring performed during routine operations, most of this information will be based on past operating experience.

4.1.7 Closure Certification

"When closure is completed, the owner or operator must submit to the Regional Administrator certification both by the owner or operator and by an independent registered professional engineer that the facility has been closed in accordance with the specifications in the approved closure plan."*

An independent professional engineer is required to certify that closure activities were performed in accordance with the closure plan. It is not expected that an engineer will perform detailed tests. The owner or operator will include in the plan an estimate of the number of periodic inspections to be made by an engineer. The plan need not include the name and state professional engineer's license number of the engineer, although this will be required later as documentation.

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*EPA Interim Status Standards, 40 CFR §265.115.

4.1.8 Requirements for Some Facilities

Some facilities, because of their site-specific characteristics, e.g., facility design or location, may require additional activities at closure. These additional requirements include:

- Collecting, removing and treating leachate
- Gas collection
- Installing or maintaining fences

Collecting, Removing and Treating Leachate

If a system for collecting, removing and treating leachate is present at an impoundment, the owner or operator must include plans for its operation during the closure period. Procedures will be similar to those during operation and include monitoring, collecting, removing, treating, and disposing of leachate. Since these procedures are only required at facilities that have such a system in place, it is expected that an owner or operator will continue to operate as he has done during facility life.

For facilities with such a system, a description of procedures might include:

- Procedures for collecting and pumping leachate (e.g., leachate may collect in a sump and be pumped to a holding tank or pond or collected by portable equipment such as a vacuum truck;
- Monitoring program;
- Approximate volume of leachate collected during closure which will be a function of the length of closure;
- Location and procedures for leachate treatment (including methods for storing, pretreating, and treating, e.g.,

biological or physical-chemical treatment, evaporation, package treatment facility);

- A description of procedures including the design objectives of the treatment chosen and all materials and equipment required;
- Procedures for treating and disposing of leachate (e.g., transport/pumping procedures, procedures for discharging, including NPDES permit number as required under the Clean Water Act, if applicable, or off-site services);
- Procedures for disposing or removing residuals from treatment (e.g., on-site or off-site); and
- Maintenance required during the closure period to ensure that the system is operating properly before post-closure begins, which may include:
  - Repairs to parts of the system,
  - Replacing and reinstalling parts, and
  - Routine maintenance.

Gas Collection

If a gas collection system is required during operation, an owner or operator should include in the closure plan the monitoring procedures to be followed during the closure period. Monitoring will likely be similar to that required during operation, and the details can therefore be based on the owner's or operator's operating records. The closure plan will include:

- Procedures for collecting gas, including:
  - Design objectives of system, and
  - Materials and equipment required;
- Details of monitoring required during closure which will be based on the length of the closure period, including the type and number of samples and analyses and whether analyses are done on- or off-site; and

- Maintenance required during the closure period to ensure that the system is operating properly before post-closure begins, which may include:
  - Repairs to parts of the system,
  - Replacement and reinstallation of parts, and
  - Routine maintenance.

Installing or Maintaining Fences

At some facilities, it may be desirable to restrict access, in accordance with the security regulations, Subpart B, §265.14, even after the facility has been closed. Although this requirement is at the Regional Administrator's discretion, the owner or operator should use his judgment, considering factors such as facility location, surrounding land use, and types of wastes buried to decide whether to include a security provision in the plan. At facilities in which access will be restricted during the post-closure care period, owners or operators will address either the maintenance of security equipment used during the active life of the facility or installation of appropriate security equipment. In most cases, this will likely mean that an owner or operator will install a fence or ensure that the existing fence is in good condition at the time of closure.

If an owner or operator plans to install a fence at closure, the closure plan should state the area of the facility that will be enclosed by the fence, the type of materials to be used, and dimensions of the fence. If a fence is already installed at the facility, the plan will describe the types of repairs expected to be needed to ensure that it is in good condition when post-closure begins.

4.2 SURFACE IMPOUNDMENTS IN WHICH WASTES ARE REMOVED AT CLOSURE

"(a) At closure, the owner or operator may elect to remove from the impoundment:

(1) Standing liquids;
(2) Waste and waste residues;
(3) The liner, if any; and
(4) Underlying and surrounding contaminated soil.

(b) If the owner or operator removes all the impoundment materials in paragraph (a) of this Section, or can demonstrate under §261.3(f) of this Chapter that none of the materials listed in paragraph (a) of this Section remaining at any stage of removal are hazardous wastes, the impoundment is not further subject to the requirements of this Part."*

4.2.1 Introduction

The instructions and the outline are separated into the following major headings which correspond with the regulations applicable to impoundments in which wastes are removed at closure. The closure plan should include a general description of facility conditions and must include descriptions of the activities required to comply with the following requirements:

- Removing of Inventory
- Decontaminating the Facility
- Ground-water Monitoring
- Closure Certification

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*EPA Interim Status Standards, 40 CFR §265.228(a) and (b).

4.2.2 Facility Conditions

The primary purpose of this portion of the closure plan is to provide the Regional Offices with the information for an initial check of the adequacy of the closure plan. This section of the plan contains a description of the factors determining the conditions of the facility, including the capacity of the impoundment, the maximum amount of inventory expected to accumulate on-site during operations, a description of equipment and facilities, and a complete schedule of closure activities. With this information readily available, an EPA inspector can quickly evaluate the closure plan using a visual inspection to confirm that facility conditions never exceed the specifications described in the first part of the closure plan.

General Information

General information that would be useful in a closure plan includes:

- Facility size;
- Volume of impoundment;
- Type of treatment
- Copy of NPDES permit, if the impoundment discharges through a point source to U.S. waters; and
- Procedures and schedules for dredging during operation, if applicable.

It is likely that during the course of normal operations the impoundment will be dredged. The closure plan should provide a schedule for these periodic dredgings, if applicable, which will include:

- Volume of waste dredged;
- Frequency of dredging;

- Procedures for dredging; and
- Method of disposing of dredged material.

Partial Closure

An owner or operator may partially close the impoundment during facility operations by diking off areas of the impoundment which are no longer to be used and properly closing those areas. Partial closure includes those activities that reduce what needs to be done at final closure to comply with the regulations. The closure plan must include plans to close the largest areas of the impoundment that will be open at any given time. If an owner or operator intends to partially close the impoundment, the closure plan must include "a description of how and when the facility will be partially closed, if applicable, and ultimately closed".* The plan must provide a schedule of these activities and a description of:

- The size of the area partially closed;
- Frequency of these partial closures; and
- Procedures for removing all hazardous wastes and partially closing the area.

The key factor about partial closure which must be made clear in the closure plan is that partial closure procedures (i.e., activities which reduce the requirements at final closure) must be in accordance with the technical closure requirements and consistent with the plans for final closure. Therefore, an owner or operator of an impoundment in which wastes are removed at closure must remove and properly dispose of all hazardous wastes from areas which are partially closed.

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*EPA Interim Status Standards, 40 CFR §265.112(a)(1).

Maximum Amount of Waste

The owner or operator must include in the closure plan "an estimate of the maximum inventory of wastes in storage or in treatment at any given time during the life of the facility."* This estimate of the maximum amount of inventory ever expected over the life of the facility enables an inspector to evaluate this portion of plan based on a visual inspection of the facility.

Equipment and Facilities

The owner or operator should describe the kinds of equipment and facilities on-site (e.g., transport vehicles, excavation equipment, spreaders, etc.), to enable an inspector to quickly evaluate the proposed plans for decontaminating the facility.

Schedule of Final Closure

The closure plan must include a "schedule for final closure which must include, as a minimum, the anticipated date when wastes will no longer be received, the date when completion of final closure is anticipated, and intervening milestone dates which will allow tracking of the progress of closure. (For example, the expected date for completing treatment or disposal of waste inventory must be included, as must the planned date for removing any residual wastes from storage facilities and treatment processes.)"**

The closure period begins with the final acceptance of waste and concludes when closure has been certified by the professional engineer.* The schedule of closure activities applicable to surface impoundments in which wastes are removed at closure should include:

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*EPA Interim Status Standards, 40 CFR §265.112(a)(2).

**EPA Interim Status Standards, 40 CFR §265.112(a)(4).

- Final date for accepting wastes;
- Date all treatment completed;
- Date that all standing liquids will have been removed;
- Date that all sludge will have been removed;
- Final date facility decontaminated;
- Final date of closure, which is the date that closure has been certified by the professional engineer;
- The total time required to close the facility, i.e., time from the final acceptance of waste to certification by the professional engineer;
- Justification if closure will take longer than six months from the date of the final acceptance of wastes (§265.113(b)). If an owner or operator requires more than six months to complete closure, the closure plan must include a justification for the need for additional time as well as proof that all steps have been taken to eliminate all threats to human health and the environment. A further discussion of closure schedules is in Section 2.2.6.

4.2.3 Removing Inventory

An owner or operator of an impoundment must include in the closure plan:

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*The final date of closure referred to here is the date that the closure technical requirements have been certified by the professional engineer. The final date of closure, for purposes of financial responsibility requirements is the date that the Regional Administrator releases the closure fund to the owner or operator. A discussion of the legal implications of closure certification is in Section 2.2.8.

- An estimate of the maximum amount of inventory reasonably expected on-site over the life of the facility;
- Methods and procedures for treating or removing all inventory, including processing residues; and
- Time schedule.

Maximum Inventory

The closure plan must include "an estimate of the maximum inventory of wastes in storage or in treatment at any given time during the life of the facility".* Inventory, in the case of impoundments in which all wastes are to be removed at closure, includes all wastes in all stages of processing, including wastes in storage and in the impoundment.

The estimate of inventory must be based on the maximum amount ever expected to be on-site over the life of the facility, assuming normal conditions. It should always be high enough to ensure that if an inspector came onto the facility, the amount of inventory would not exceed the estimate in the plan, assuming normal operating conditions.

Since accumulating inventory has often been the cause of severe environmental damage, an owner or operator should keep the amount of wastes in storage to a minimum. Requiring in the closure plan an estimate of the maximum amount of inventory also alerts the Regional Administrator to a potential hazard if a visual check of the facility shows that the estimate in the plan has been exceeded. If the amount of wastes on-site ever exceeds the estimate in the plan, the owner or operator must revise the plan to reflect actual conditions; however, if the owner or operator can justify to the Regional Administrator that the excess inventory is a result of unexpected operating conditions and the original estimate of maximum inventory can be restored quickly, the Regional Office might not require the owner or operator to revise the plan. A further discussion of maximum inventory is in Section 2.2.4.

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*EPA Interim Status Standards, 40 CFR §265.112(a)(2).

Methods and Procedures for Treating and Removing Inventory

The procedures to be followed are very site-specific and must be described in the closure plan. At a minimum, the owner or operator will describe procedures necessary to complete the following activities:

- Operating the facility in a routine manner while treating all hazardous wastes in storage and in the impoundment which are to be removed by evaporation or treated and discharged;
- Removing and transporting all liquids, not removed by evaporation or treated and discharged on-site, to an operating permitted facility or a facility operating under interim status; and
- Removing all hazardous sludge and other hazardous wastes from the impoundment.

The closure plan should include a description of procedures to be used for treating all wastes in storage and removing all standing liquids. If wastes are to be discharged, the owner or operator must comply with the Clean Water Act. An owner or operator may prefer to transfer some liquids to another facility because of operating problems or because treatment is taking longer than anticipated. In this case, the owner or operator should include an estimate of the amount disposed off-site and ensure that the receiving facility is either permitted or operating under interim status.

An owner or operator must include plans for removing and managing all hazardous sludges, and procedures for sludge stabilization if performed on-site. Under these regulations, an owner or operator is only required to remove and manage the hazardous solid wastes from the impoundment. Upon removing the sludge from the impoundment, he becomes a generator of hazardous waste and must manage it in accordance with all applicable requirements of Parts 262, 263 and 265 of this Chapter."*

The closure plan should include an estimate of the quantity of sludge to be removed and the procedures to be used. If disposed on-site, the owner or operator must have an available permitted disposal area or one with interim status. The owner or operator also must comply with all regulations applicable to disposal facilities, including post-closure care. If removed to an off-site TSDF, the owner or operator should ensure that the receiving facility is either permitted or operating under interim status.

Time Schedule

Accumulating inventory over long periods of time has often been the cause of serious environmental damages; thus, the regulations restrict the amount of time allotted during closure for removing all wastes:

> "Within 90 days after receiving the final volume of hazardous wastes, the owner or operator must treat all hazardous wastes in storage or in treatment, or remove them from the site, or dispose of them on-site, in accordance with the approved closure plan."**

The owner or operator of an impoundment should include an estimate of the time required for treatment and removal of wastes. If treatment processes routinely take longer than 90 days, the plan should include a justification for this extension, subject to the Regional Administrator's approval.

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*EPA Interim Status Standards, 40 CFR §265.228 (Comment).

**EPA Interim Status Standards, 40 CFR §265.113(a).

4.2.4 Decontaminating the Facility

The closure plan must include "a description of the steps needed to decontaminate facility equipment during closure."* According to the regulations, "when closure is completed, all facility equipment and structures must have been properly disposed of, or decontaminated by removing all hazardous waste and residues."** The closure plan should include a description of the cleaning, testing and/or disposing of all items so that no hazardous materials remain on-site. This will include cleaning up or disposing of contaminated equipment, soils and residues. The degree of cleanup required at a given facility at the time of final closure will vary according to the owner's or operator's operating practices.

Decontaminating the Soil

The closure plan will include a list of all areas with potentially contaminated soil requiring removal and disposal, an estimate of the quantity of contaminated soil to be disposed, and a description of disposal methods. Cleanup of hazardous waste drips and spills will be part of routine operating practices. The residues included in the closure plan are those on the surrounding grounds as a result of closure operations and those not previously cleaned up (e.g., residues on dikes, storage areas, trenches, diversions, spill containment areas). Soil testing may be necessary depending on the facility conditions; the owner or operator should state in the plan the criteria used to determine the amount of contaminated soil to be disposed or removed to an off-site TSDF. An owner or operator will need to refer to Section 261 of these regulations, "Identification and Listing of Hazardous Wastes," for the criteria for identifying the characteristics of hazardous wastes. Contaminated soil may be either disposed on-site in a separate permitted landfill, one operating under interim status, or disposed off-site to a TSDF. If disposed on-site at a multiple process facility, the owner or operator must prepare a closure and post-closure plan for the landfill.

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*EPA Interim Status Standards, 40 CFR §265.112(a)(3).

**EPA Interim Status Standards, 40 CFR §265.114.

Decontaminating the Equipment and Facility

The closure plan may include a description of procedures used to decontaminate or dispose of the following:

- All transport and storage containers, tanks and ancillary facilities;
- All equipment, including that used for transport, storage, treatment disposal and cleaning processes;
- Cleaning wastes and residues from cleaning; and
- Any remaining water on-site from rain or snow.

The owner or operator must include in the closure plan a description of procedures for cleaning all equipment and facilities, an estimate of the amount of residues resulting from cleaning (e.g., residues from the cleaning process, cleaning fluids that are hazardous, wastewaters, containers), and plans for their disposal or removal to an off-site TSDF. For facilities at which it is common for water to accumulate as a result of rain or snow, the closure plan must provide for removing excess water at the time of closure.

An owner or operator will either choose to dispose of all residues from decontamination off-site or will dispose of them on-site if a disposal facility is available. As discussed above in Section 4.2.3, if wastes are disposed of in a trench on-site, an owner or operator must also perform post-closure care.

4.2.5 Ground-water Monitoring

Ground-water monitoring "must be carried out during the active life of the facility."* The closure plan must include provisions for monitoring throughout the closure period until the professional engineer certifies that closure has been completed. Monitoring will be in accordance with the requirements specified in §265.90 et seq. of these regulations.

The simplest way to describe the monitoring to be performed during closure is to include a copy of the facility's ground-water sampling and analysis program. Since this program will not be implemented until one year after the effective date of these regulations, the Agency will be developing guidance for preparing monitoring plans. This document is not intended to provide guidance in this area; therefore, it is expected that, in developing the closure plan, an owner or operator will use his judgment in describing appropriate ground-water monitoring as required by §265.90 et seq. and revise the plan when more data and guidance become available. The closure plan should include a copy of the facility's ground-water sampling and analysis program when it is available.

Analyses Required During Closure

According to the ground-water monitoring regulations, samples collected to establish ground-water quality must be obtained and analyzed for the following parameters at least annually:

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*EPA Interim Status Standards, 40 CFR §265.90(a).

- chloride
- iron
- manganese
- phenols
- sodium
- sulfate

Samples collected to indicate ground-water contamination must be obtained and analyzed for the following parameters at least semi-annually:

- pH
- specific conductance
- total organic carbon
- total organic halogen

The closure plan should include the maximum number and types of ground-water analyses required during the closure period. The number and types of sampling and analyses required during closure depend on the length of the closure period. For example, if one set of analyses are required annually and the others are required semi-annually, the owner or operator should allow in his plan for the possibility that both sets of analyses will be required within the closure period, in order to make provisions for the maximum number of analyses. For this reason the closure plan may need to include a schedule of more analyses than will actually be performed during closure.

4.2.6 Closure Certification

"When closure is completed, the owner or operator must submit to the Regional Administrator certification both by the owner or operator and by an independent registered professional engineer that the facility

has been closed in accordance with the specifications in the approved closure plan."*

An independent professional engineer is required to certify that closure activities were performed in accordance with the closure plan. It is not expected that an engineer will perform detailed tests. The owner or operator will estimate the number of periodic inspections to be made by an engineer and include it in the plan. The plan need not include the name and state professional engineer's license number of the engineer, although this might be required later as documentation.

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*EPA Interim Status Standards, 40 CFR §265.115.

4.3 SAMPLE CLOSURE PLAN OUTLINE: SURFACE IMPOUNDMENTS IN WHICH WASTES REMAIN AT CLOSURE

EPA Facility ID No. ______________________________

Owner's or Operator's Name ______________________________

Address & Phone No. ______________________________

Facility Address ______________________________

I. FACILITY CONDITIONS
  A. General information
    1. Size of impoundment facility (include reference map)
    2. Volume of impoundment
    3. Type of treatment
    4. Copy of NPDES water pollution control permit if you discharge through a point source to U.S. waters
    5. Schedule of dredging, if applicable
      a. Volume of waste dredged
      b. Frequency of dredging
      c. Procedures for dredging
      d. Method of disposal of dredged materials
  B. Schedule of partial closures, if applicable (milestone chart)
    1. Size of each area partially closed
    2. Methods for partial closure (removal of wastes or cover)
    3. Maintenance of partially closed areas
  C. Maximum amount of waste ever on-site in any stage of processing
    1. Maximum volume of waste in impoundment
    2. Maximum volume of waste in storage awaiting impoundment
  D. Inventory of auxiliary equipment
  E. Schedule of final closure (milestone chart)
    1. Final date wastes accepted
    2. Date all treatment completed
    3. Date all free liquids removed
    4. Date facility decontaminated

5. Date final cover completed
6. Final date vegetative cover planted or other material placed
7. Final date closure completed
8. Total time required to close facility
9. Justification if closure is longer than six months

II. REMOVING ALL INVENTORY

A. Maximum amount of waste on-site in any stage of processing
    1. Total amount of wastes in drums and number of drums in storage, if applicable
    2. Volume of bulk wastes in any stage of processing including storage
    3. Total amount of residues from processing
    4. Maximum quantity of liquid in impoundment

B. Procedures for treating or disposing of inventory, including free liquids, on-site
    1. Amount of inventory treated on-site
    2. Method of treatment (e.g., package treatment facility, evaporation, biological treatment)
    3. Method of discharge or disposal
    4. Time estimate for treatment or disposal, if disposed of in a landfill on-site

C. Method of stabilizing sludge.
    1. Type of bulking agent used
    2. Amount of bulking agent required
    3. Source of material
    4. Equipment required for stabilizing sludge
    5. Availability of equipment

D. Sludge disposal, if applicable
    1. Quantity of sludge to be disposed
    2. Procedures for sludge disposal
        a. State if disposed in another section of impoundment

            b. If disposed on-site in landfill, describe procedures
            c. If removed to an off-site TSDF
                (1) Method of treatment or disposal
                (2) Approximate distance to TSDF
    E. Procedures for off-site treatment or removal of inventory
        1. Quantity of wastes removed to an off-site TSDF
        2. Method of off-site treatment or disposal
        3. Approximate distance to TSDF

III. DECONTAMINATING THE FACILITY
    A. Area of facility with potential soil contamination (sq. yd.)
        1. List areas with potential contaminated soil
            a. Number of soil samples, if necessary
            b. Criteria for determining contamination
        2. Estimated depth of soil requiring removal
        3. Total amount of contaminated soil (cu. yd.)
            a. Amount of contaminated soil disposed on-site and method of disposal
            b. Amount of contaminated soil disposed off-site
    B. All equipment and/or facilities (e.g., tanks, basins, earth-moving equipment, piping and containers) requiring decontamination
        1. Name each piece of equipment and/or storage facilities and procedures for cleaning (e.g., steam-cleaning, hydroblasting, etc.)
            a. Owner or operator labor or contractor
            b. Quantity of residues from cleaning
        2. Number of containers requiring disposal or decontamination
            a. Method of cleaning and/or disposal of containers
            b. Volume of residues
        3. Method for treating or disposing of residues from decontamination (including wastewater and liquid wastes)
            a. Quantity treated or disposed of on-site and method of treatment or disposal

b. Quantity removed off-site

4. Estimated amount of water on-site requiring removal (e.g., snow and rain accumulation)

a. Methods for removal

b. Source of disposal (on-site versus off-site)

(1) If on-site disposal area

(a) Procedures

IV. COVER AND VEGETATION

A. Final cover

1. Total area to be covered (sq. yd.) (line a + line b)

a. Area of facility not previously partially closed with appropriate cover

b. Area of any portions of facility open to dispose of inventory and wastes from decontamination

2. Characteristics of final cover

a. Type(s) of material(s) (e.g., soil of 10^{-7} cm/sec permeability)

b. Depth of material(s)

c. Total amount of material(s) required

d. Amount and type of soil additives, if applicable

e. Source of material(s)

(1) Quantity available on-site

(a) Excavation required

(b) Approximate hauling distance

(2) Amount purchased off-site

(a) Approximate hauling distance

3. Final cover design

a. Slope of cover

b. Length of run of slope

c. Type of drainage and diversion structures

    4. Earth-moving procedures
        a. Contractor or owner or operator to lay cover?
        b. Equipment needed for hauling, spreading, grading, compacting
        c. Available on-site or rental?

B. Vegetation (if not planting vegetation, omit parts 1 through 3)
    1. Total area requiring vegetation (acres)
        a. Area of final cover which will have vegetation (acres)
        b. Area partially closed but never vegetated (acres)
        c. Area previously vegetated but requiring some replanting (acres)
        d. Percentage of total area assumed to require replanting during closure (%) (number of acres)
    2. Characteristics of vegetation
        a. Name or type of vegetation (e.g., rye grass)
        b. Climatic, soil and maintenance requirements (e.g., temperature, moisture and nutrients requirements, replanting frequency)
        c. Root structure (expected penetration depth of roots)
    3. Soil preparation procedures
        a. Type and quantity of fertilizer required per acre; total required
        b. Quantity of seed required per acre; total required
        c. Type and quantity of mulch required per acre; total required
        d. Contractor labor or owner or operator labor?
    4. Procedures for controlling cover erosion if vegetation is not to be planted
        a. Type and quantity of materials to be used
        b. Justification for materials chosen

V. GROUND-WATER MONITORING

A. Analyses required during closure

1. Maximum number of ground-water quality analyses required during closure
2. Maximum number of ground-water contamination analyses required during closure
3. Details of ground-water monitoring program (include copy of ground-water sampling and analysis program when available)

B. Maintenance of monitoring equipment

1. Number of wells requiring redrilling
2. Number of wells requiring replacement
3. Need for replacement parts to system (name parts, e.g., pumps, seals, caps)
4. Required routine maintenance

VI. CLOSURE CERTIFICATION

A. Approximate number or schedule (e.g., every two weeks) of periodic inspections expected by certified professional engineer

VII. COLLECTING, REMOVING AND TREATING LEACHATE

If a leachate collection, removal and treatment system is installed at your facility, complete this section.

A. Describe your leachate collection system (i.e., pumping and collecting procedures

1. Describe the monitoring system
2. Estimated volume of leachate collected per month

B. Describe leachate treatment process

1. Is treatment on-site or off-site? If on-site treatment, describe process for treatment
    - a. Design objectives
    - b. Materials and equipment required

C. Disposing of leachate

1. If discharged to public waters, refer to water pollution control permit number in Section I - "Facility Conditions"
2. If hauling off-site, distance to TSDF
3. Disposing of residuals
    a. Quantity of residuals
    b. Characteristics
    c. If disposed on-site, where? (including drawing of disposal area)
    d. If off-site, distance to TSDF
4. Maintaining equipment
    a. Repairs and replacements required
    b. Regular maintenance required over the duration of closure

VIII. GAS COLLECTION

If a gas collection system exists at your facility, complete this section.

A. Procedures for collecting gas
    1. Design objectives of system
    2. Materials and equipment required

B. Monitoring requirements
    1. Type of monitoring samples
    2. Number of samples
    3. Type of analysis
    4. Where are analyses performed?

C. Maintenance of monitoring equipment
    1. Repairs required during closure
    2. Replacements required during closure
    3. Routine maintenance required during the closure period

IX. INSTALLING OR MAINTAINING THE FENCE

A. If fence already exists at your facility, describe required maintenance at closure to ensure it is in good condition

B. If fence is to be installed:

1. Area to be enclosed
2. Type of materials used
3. Dimensions of fence

4.4 SAMPLE CLOSURE PLAN OUTLINE: SURFACE IMPOUNDMENTS IN WHICH WASTES ARE REMOVED AT CLOSURE

EPA Facility ID No. ____________________

Owner's or Operator's Name ____________________

Address & Phone No. ____________________

Facility Address ____________________

I. FACILITY CONDITIONS
  A. General information
    1. Size of impoundment facility (include reference map)
    2. Volume of impoundment
    3. Type of treatment
    4. Copy of NPDES water pollution control permit if you discharge through a point source to U.S. waters
    5. Schedule of dredging, if applicable
      a. Volume of waste dredged
      b. Frequency of dredging
      c. Procedures for dredging
      d. Method of disposal of dredged materials
  B. Schedule of partial closures, if applicable (milestone chart)
    1. Size of each area partially closed
    2. Methods for partial closure (cover or removal of wastes)
    3. Maintenance of partially closed areas
  C. Maximum amount of waste ever on-site in any stage of processing
    1. Maximum volume of waste in impoundment
    2. Maximum volume of waste in storage awaiting impoundment
  D. Inventory of auxiliary equipment
  E. Schedule of final closure (milestone chart)
    1. Final date wastes accepted
    2. Date all treatment completed
    3. Date all free liquids removed
    4. Date all sludges removed
    5. Date facility decontaminated

6. Final date of completed closure
7. Total time required to close facility
8. Justification if closure is longer than six months

II. REMOVING ALL INVENTORY

A. Maximum amount of waste on-site in any stage of processing
    1. Total amount of wastes in drums and number of drums in storage, if applicable
    2. Volume of bulk wastes in any stage of processing including storage
    3. Total amount of residues from processing
    4. Maximum quantity of liquid in impoundment
    5. Maximum quantity of sludge in impoundment

B. Procedures for treating or disposing of inventory, including free liquids, on-site
    1. Amount of inventory treated on-site
    2. Method of treatment (e.g., package treatment facility, evaporation, biological treatment)
    3. Method of discharge or disposal, if disposed in a landfill on-site
    4. Time estimate for treatment

C. Procedures for removal of all liquids not treated and disposed on-site
    1. Quantity of liquids not treated and discharged on-site
    2. Method of off-site treatment or disposal
    3. Approximate distance to off-site TSDF

D. Removing sludge
    1. Volume of sludge to be removed
    2. Method for removing sludge and residuals
        a. Is equipment on-site or rental required?
        b. Owner or operator labor or contractor?
    3. Treating sludge
        a. If treatment is performed on-site, describe treatment

- b. Stabilizing sludge
  - (1) Type of bulking agent used
  - (2) Amount of bulking agent required
  - (3) Source of material
  - (4) Equipment required
  - (5) Availability of equipment
- 4. Disposing of sludge
  - a. If on-site disposal, provide map of disposal location
    - (1) Quantity disposed on-site
    - (2) Size of area needed for disposal
    - (3) Procedures for disposal
  - b. If off-site treatment or disposal
    - (1) Quantity removed to an off-site TSDF
    - (2) Method of treatment or disposal (e.g., landfill, etc.)
    - (3) Approximate distance to TSDF

III. DECONTAMINATING THE FACILITY

- A. Area of facility with potential soil contamination (sq. yd.)
  - 1. List areas with potential contaminated soil
    - a. Number of soil samples, if necessary
    - b. Criteria for determining contamination
  - 2. Estimated depth of soil requiring removal
  - 3. Total amount of contaminated soil (cu. yd.)
    - a. Amount of contaminated soil disposed on-site
      - (1) Method of disposal
      - (2) Construction required if applicable
      - (3) Size, location and design of on-site disposal method
    - b. Amount of contaminated soil disposed off-site

B. All equipment and/or facilities (e.g., tanks, basins, earth-moving equipment, piping and containers) requiring decontamination

  1. Name each piece of equipment and/or storage facilities and procedures for cleaning (e.g., steam cleaning, hydro-blasting, etc.)
     a. Owner or operator labor or contractor
     b. Quantity of residues from cleaning
  2. Number of containers to be disposed or decontaminated
     a. Method of cleaning and/or disposing of containers
     b. Volume of residues
  3. Method for disposing of residues from decontamination (including wastewater and liquid wastes)
     a. Quantity managed on-site
        (1) Method of treatment or disposal method
        (2) Size, location and design of on-site disposal method
        (3) Disposal plans for liquid waste
     b. Quantity disposed off-site
  4. Estimated amount of water on-site requiring removal (e.g., snow and rain accumulation)
     a. Methods for removal
     b. Source of treatment or disposal (on-site versus off-site)
        (1) If on-site, describe procedures

IV. GROUND-WATER MONITORING

A. Analyses required during closure

  1. Maximum number of ground-water quality analyses required during closure
  2. Maximum number of ground-water contamination analyses required during closure
  3. Details of ground-water monitoring program (include copy of ground-water sampling and analysis program when available)

B. Maintenance of monitoring equipment
   1. Number of wells requiring redrilling
   2. Number of wells requiring replacement
   3. Need for replacement parts to system (name parts, e.g., pumps, seals, caps)
   4. Required routine maintenance

V. CLOSURE CERTIFICATION
   A. Approximate number or schedule (e.g., every two weeks) of periodic inspections

5.0 LAND TREATMENT FACILITIES:
GUIDANCE FOR DEVELOPING CLOSURE PLANS

5.1 INTRODUCTION

Land treatment is a waste management practice that involves applying and incorporating waste into the surface soil. In effective land treatment this surface layer of soil acts as a biochemical "reactor" where, ideally, soil micro-organisms consume the organic components of the waste and transform them into cellular matter and harmless materials such as carbon dioxide. The nondegradable portion of the wastes applied to land treatment facilities (e.g., metals, complex organics) are immobilized by chemical reactions in the soil. These nondegradable waste constituents, over a period of time, accumulate in the surface soil.

The following material provides instruction for the EPA Regional Offices and the regulated community concerning the preparation of closure plans. Following the instructions is a sample closure plan outline which illustrates the concepts and intentions of the plan. This document and the accompanying outline are intended merely as guidance and many parts of them may not be applicable to any given facility. This guidance is based on the assumption that the land treatment facility has been operating properly, and that no special requirements will be necessary to ensure adequate closure. The purpose of this document is not to provide guidance for remedial measures, but rather to provide assistance to owners or operators of well-operated facilities in developing closure plans. A general discussion of conceivable problems that might exist at some land disposal facilities and the kinds of measures that might be needed is included in Chapter 9.0, "Closure and Post-Closure Activities Required at Some Disposal Facilities."

The instructions for developing closure plans and the accompanying outline include all types of activities which may be applicable to the following three possible closure scenarios for land treatment facilities:

(1) Land treatment facility in which, at the completion of closure, no hazardous constituents remain in the soil;
(2) Land treatment facility in which hazardous constituents remain at closure and the contaminated soil is removed; and
(3) Land treatment facility in which hazardous constituents remain at closure and the facility is stabilized to control the migration of wastes.

When developing a closure plan during interim status, the owner or operator should assume that the facility's treatment operations will be successful if the facility has been operating properly to date. If the treatment is expected to render all wastes non-hazardous and, at the time the plan is written, the treatment is working as anticipated, the owner or operator should base his closure plan on the assumption that no wastes will remain at closure. An owner or operator of a land treatment facility in which no wastes will remain at closure must include in the closure plan provisions for the continued degradation of any remaining degradable components and provisions for testing to demonstrate compliance with the closure regulations specified in §265.280. If no wastes remain at the completion of closure, post-closure care will not be required.

An owner or operator of a treatment facility which renders wastes less hazardous must base his closure plan on the assumption that, at closure, he will either remove the remaining contaminants or stabilize the facility to control waste migration. If he does not plan to remove the contaminated soil, he must also prepare a post-closure plan providing for soil and ground-water monitoring and maintenance.

The owner or operator may assume that the land treatment will be successful and that only routine closure activities will be required. If, however, during the course of operations, he finds that the treatment is not rendering the wastes non-hazardous, he *must* change his assumptions and develop a new closure plan. The owner or operator should always be sure that the closure plan is appropriate for the conditions that exist at the time the plan is written.

In preparing the closure and, if applicable, post-closure plans, the owner or operator must address how the facility will be closed "in a manner that (a) minimizes the need for further maintenance, and (b) controls, minimizes or eliminates, to the extent necessary to protect human health and the environment, post-closure escape of hazardous waste, hazardous waste constituents, leachate, contaminated rainfall, or waste decomposition products to the ground water, or surface waters, or to the atmosphere."*

The terms "human health," "environment" and "control" are all relative terms. In some cases, protection of human health and environment may mean no discharge, while in other cases, some escape may be acceptable. To meet these objectives, the owner or operator must develop as part of his closure and post-closure plans, an adequate analysis of the effectiveness of the proposed closure and post-closure procedures.

The instructions and the outline are separated into the following major headings:

- Facility Conditions
- Removing Inventory
- Material in Treatment

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*EPA Interim Status Standards, 40 CFR §265.112(a).

- Decontaminating the Facility
- Removing Contaminated Soil
- Cover and Vegetation
- Monitoring Operations
- Closure Certification
- Food Chain Crops

The closure plan for a land treatment facility will differ depending on how the facility is closed, as discussed above. The instructions are meant to be inclusive, and therefore, all section will not be applicable to all land treatment facilities.

5.2 FACILITY CONDITIONS

The primary purpose of this portion of the closure plan is to provide the Regional Offices with the information for an initial check of the adequacy of the closure plan. This section of the plan contains a description of the key factors determining the condition of the facility; that is, a general description of the facility, the maximum extent of the acreage that will be unclosed during the active life of the facility, the maximum amount of inventory ever on-site during operations, a description of equipment, and a complete schedule of closure activities. With this information readily available, an inspector can quickly evaluate the closure plan using a visual inspection to confirm that facility conditions never exceed the specifications in the first part of the closure plan.

5.2.1 General Information

The closure plan should include a general description of the facility, including:

- Facility size;
- Topography;
- Soil type;
- Storage facilities (including all tanks, surface impoundments, drainage pits, etc.);
- Other waste facilities on-site, if applicable; and
- Waste characterization.

5.2.2 Maximum Extent of Operation

According to the regulations, the description of closure activities "must identify the maximum extent of operation which will be unclosed during the life of the facility."* In the case of land treatment facilities, the extent of operation is a function of the types of wastes which are treated, the rate of waste decomposition, and the amount of treatment required during the closure period. Particular areas of the facility will likely require different kinds of activities at closure, depending on the wastes that are being treated in each particular area, their decomposition rate, and how recently the wastes have been landspread. The more recently the wastes have been spread, the more extensive the treatment activities that are needed. Therefore, in order to assume the maximum extent of operation in the closure plan, the owner or operator should assume that: (1) the largest area ever containing wastes in any stage of treatment over the life of the facility is in operation; and (2) the largest area ever spread at one time has most recently been spread with the wastes that require the most extensive treatment.

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*EPA Interim Status Standards, 40 CFR §265.112(a)(1).

5.2.3 Maximum Inventory

The owner or operator must include in the closure plan "an estimate of the maximum inventory of wastes in storage or in treatment at any given time during the life of the facility."* The amount of waste stored on-site awaiting landspreading in the land treatment fields is a key factor influencing the amount of activity and the length of time needed to achieve closure. The estimate of maximum inventory enables the Regional Office to evaluate this portion of the closure plan based on a visual inspection of the facility.

5.2.4 Equipment and Facilities

The owner or operator should describe in the closure plan the kinds of equipment and facilities on-site to enable an inspector to quickly evaluate the proposed plans for facility decontamination.

5.2.5 Schedule of Activities

The closure plan must include "a schedule for final closure which must include, as a minimum, the anticipated date when wastes will no longer be received, the date when completion of final closure is anticipated, and intervening milestone dates which will allow tracking of the progress of closure. (For example, the expected date for completing treatment or disposal of waste inventory must be included, as must the planned date for removing any residual wastes from storage facilities and treatment processes.)"**

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*EPA Interim Status Standards, 40 CFR §265.112(a)(2).

**EPA Interim Status Standards, 40 CFR §265.112(a)(4).

The closure period begins with the final acceptance of wastes and concludes when closure has been certified by the professional engineer.* The schedule of closure activities for a land treatment facility should include:

- Final date wastes accepted;
- Date all landspreading completed;
- Final date all waste decomposition completed;
- Final date facility decontaminated;
- Final date all decontaminated soil removed, if applicable;
- Date final cover completed, if applicable;
- Final date vegetative cover planted, if applicable (this date should be the date that planting is completed);
- Final date of closure and the effective date of post-closure, if applicable (the date when closure has been certified by the professional engineer);
- The total time required to close the facility (the time from the final acceptance of waste to completion of all treatment); and
- Justification if closure will take longer than six months from the date of the final acceptance of wastes (§265.113(b)). A further discussion of closure schedules is in Section 2.2.6.

The Agency anticipates that the closure period, i.e., the period from the final acceptance of waste to the professional engineer certification, for most land treatment facilities will extend beyond the mandated six-month limit due to the relatively slow rate of waste decomposition. The Agency will favorably receive any reasonable requests for a longer closure period for a land treatment facility "if the owner or operator can demonstrate that: (1) the required or planned closure activities will, of necessity, take him longer than six months to complete, and (2) that he has taken all steps to eliminate any significant threat to human health and the environment from the unclosed but inactive facility."* During this extended closure period, the monitoring program will continue. After the decomposition of the waste has been completed, the closure period will be completed. If all materials have been rendered non-hazardous, no post-closure care will be required. If the treatment has not rendered the material non-hazardous, the owner or operator must either remove the material or stabilize the land and provide some post-closure care.

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*The final date of closure referred to here is the date that the closure technical requirements have been certified by the professional engineer. The final date of closure for purposes of financial responsibility requirements is the date that the Regional Administrator releases the closure fund to the owner or operator. A discussion of the legal implications of closure certification is in Section 2.2.8.

5.3 REMOVING ALL INVENTORY

An owner or operator of a land treatment facility must include in the closure plan:

- An estimate of the maximum amount of inventory reasonably expected on-site at a given time;
- Methods and procedures for disposal of all inventory, including any residues from processing; and
- Time schedule.

5.3.1 Maximum Inventory

The closure plan must include "an estimate of the maximum inventory of wastes in storage or in treatment at any given time during the life of the facility."** Inventory, in the case of land treatment facilities, includes all wastes in storage and pretreatment. It should be noted that, in some cases, an owner or operator may never accumulate inventory or have wastes in pretreatment if wastes are always landspread directly from the transport truck. If an owner or operator expects that he will accumulate inventory at any time over the life of the facility, the estimate of the quantity of wastes in storage and pretreatment must be included in the plan. The estimate must be based on the maximum amount that would ever be on-site during the life of the facility. It should always be high enough to ensure that if an inspector came onto the facility, the amount of wastes in storage as well as in pretreatment should not exceed the estimate in the plan, assuming normal operating conditions. If the amount of wastes in storage ever exceeds the closure plan estimate, the owner or operator must revise the plan to reflect actual conditions, unless the owner or operator can justify to the Regional Administrator that the excess inventory is a result of unexpected operating conditions and the original estimate of maximum inventory can be restored quickly.

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*EPA Interim Status Standards, 40 CFR §265.113(b).

**EPA Interim Status Standards, 40 CFR §265.112(a)(2).

5.3.2 Procedures for Landspreading Wastes in Storage and Treatment

The procedures to be followed are site-specific and must be described in the closure plan. It is expected that procedures will likely be a continuation of normal operating activities. The closure plan should include an estimate of the quantity of wastes requiring pretreatment and a description of pretreatment procedures, if applicable. The plan should also include a description of landspreading procedures, including application rate and acreage required.

5.3.3 Other Methods of Removing Inventory

At the time of closure, especially if operating problems occur, an owner or operator may choose to either utilize an on-site alternative method of treatment or disposal, such as landfilling, if a permitted one or one with interim status is on-site, or remove some or all remaining inventory to an off-site TSDF. In either of these cases, the plan should include the quantity of wastes to be removed and how the wastes will be treated or disposed. If the wastes are to be treated or disposed on-site, the facility must be permitted or have interim status. The owner or operator must have prepared a closure plan, and in the case of disposal facilities, a post-closure plan, accounting for these wastes. If the wastes are to be removed to an off-site TSDF, the plan should also state how the wastes will be treated and include an estimate of the approximate distance to a permitted operating facility or one operating under interim status.

5.3.4 Time Schedule

The accumulation of inventory over long periods of time has often been the cause of serious environmental damage; thus, the regulations restrict the amount of time allotted during closure for disposal of all wastes:

> "Within 90 days after receiving the final volume of hazardous wastes, the owner or operator must treat all hazardous wastes in storage or in treatment, or remove them from the site, or dispose of them on-site, in accordance with the approved closure plan."*

In the case of land treatment facilities, although the completion of the treatment process (i.e., rendering wastes either non-hazardous or less hazardous) will likely take longer than 90 days, all wastes should be landspread and mixed within the 90-day period. In some situations, however, a longer period may be necessary; for example, in northern climates, three to four months may be needed to spread all of the wastes because of adverse weather conditions. In most cases, the owner or operator should state in the plan how all of the inventory will be spread within 90 days which ensures that he either has the capability to spread all wastes within 90 days or has an alternate on-site or off-site facility available. If the owner or operator can justify that a longer period is necessary (e.g., climatic conditions), the owner or operator should provide justification in the plan and an estimate of the time required to complete the spreading.

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*EPA Interim Status Standards, 40 CFR §265.113(a).

5.4 MATERIAL IN TREATMENT

The closure plan must include a description of all procedures necessary to complete land treatment of all areas which contain hazardous wastes at the time of closure. The closure plan will include:

- An estimate of the maximum extent of operation;
- Procedures required for completion of all treatment; and
- Time required for land treatment.

5.4.1 Maximum Extent of Operation

The closure plan must account for the maximum amount of treatment likely to be required over the life of the facility. The plan, therefore, will include an estimate of the largest area ever spread with wastes over the life of the facility. In addition, the owner or operator should assume that, at closure, the largest area ever spread at one time will have been recently spread with wastes requiring the most extensive treatment. The estimate should always be high enough to ensure that, if an inspector came onto the facility, the actual conditions would not exceed the estimate in the plan. If conditions do exceed the estimate in the plan, the owner or operator must revise the plan, unless he can demonstrate to the Regional Office that the conditions are a result of unusual operating conditions and that the specifications of the plan will be restored quickly.

5.4.2 Procedures Required to Complete Treatment

The procedures to be followed are expected to be a continuation of normal operating activities. The plan should include a description of the procedures necessary to operate the facility in a routine manner for the completion of all treatment. The plan should include the kinds of activities required (e.g., tilling, soil pH, addition of nutrients) and the frequency that these activities are performed. If completing treatment will take longer than six months, the owner or operator should provide for periodic facility inspections to ensure that the facility is in proper operating condition.

5.4.3 Time Schedule

The closure plan should include an estimate of the time required to complete all waste decomposition. As discussed above in Section 5.3.4, the regulations stipulate that all wastes be treated, disposed, or removed within 90 days.

In the case of land treatment facilities, it is intended that all wastes be landspread within 90 days if possible, and that additional time will be allowed for the completion of treatment, if necessary. If an owner or operator requires more than 90 days to complete treatment, he should demonstrate in the closure plan that the longer period is required to perform closure according to routine operating procedures and that all necessary steps have been taken to eliminate any threat to human health and the environment. He should also provide an estimate of the time required to complete treatment. In cases where completing treatment requires more than six months, which is the allotted time for all closure activities (i.e., the time from the final acceptance of waste to closure certification which includes completion of treatment, decontamination procedures, vegetation if necessary, etc.), a justification for an extended closure period would include the justification for an extension of the 90-day period allotted for treating, disposing or removing inventory.

5.5 REMOVING CONTAMINATED SOIL REMAINING ON THE LAND TREATMENT FIELDS

Some land treatment facilities, either by design (e.g., nondegradable waste constituents) or due to some operating problems, will not render the hazardous wastes non-hazardous. If hazardous wastes remain, the owner or operator may choose to remove all or part of the contaminated soil at the time of closure. (If he does so, he becomes a generator of hazardous waste.) If all wastes are removed, the owner or operator does not have to provide for post-closure care.

The owner or operator will discuss in the closure plan the types of soil testing and criteria to be used to determine whether the soil is contaminated and whether removing the contaminated soil is an appropriate closure method. If, based on previous operating experience, an owner or operator anticipates that the wastes will not be rendered non-hazardous, he should include in the plan an estimate of the quantity of hazardous wastes expected to remain in the surface soil at closure and the characteristics of these constituents. If the owner or operator deems it appropriate to remove all or part of the contaminated soil, he may choose to place all of the soil in one area of the land treatment field designated as a permanent waste repository. He also may dispose of the soil on-site in a landfill if one with interim status or a permit is available, or remove it to an off-site TSDF. Regardless of the option chosen, the closure plan should include a description of the quantities of soil removed, procedures used to treat or dispose of the soil on-site, if applicable, and the approximate distance to an off-site facility if the soil is sent off-site.

5.6 DECONTAMINATING THE FACILITY

The closure plan must include "a description of the steps needed to decontaminate facility equipment during closure."* According to the regulations, "when closure is completed, all facility equipment and structures must have been properly disposed of, or decontaminated by removing all hazardous waste and residues."** The closure plan should include a description of the cleaning, testing and/or disposing of all items so that no hazardous materials remain undisposed on-site. This will include cleaning or disposing of contaminated equipment, soils and residues. The degree of cleanup required at a given facility at the time of final closure will vary according to the owner's or operator's operating practices.

5.6.1 Decontaminating the Soil

The closure plan will list all areas (outside of the active land treatment fields) with potentially contaminated soil and include a description of removal and/or disposal methods. Cleaning hazardous waste drips and spills will be a part of routine operating practices. The residues included in the closure plan are those on the surrounding soil as a result of closure operations or those not previously cleaned up. Soil testing may be necessary depending on the facility conditions; the owner or operator should state in the plan the criteria used to determine the amount of contaminated soil to be disposed. An owner or operator will need to refer to Section 261 of these regulations, "Identification and Listing of Hazardous Wastes," for the criteria for identifying the characteristics of hazardous wastes. In most cases, an owner or operator will spread the contaminated soils on the active fields. The hazardous components in the soil should be decomposed by the biological activity in the soil of the field. If any soil will be removed to a facility off-site, it should be so stated in the closure plan.

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*EPA Interim Status Standards, 40 CFR §265.112(a)(3).

**EPA Interim Status Standards, 40 CFR §265.114.

5.6.2 Decontaminating the Equipment and Facility

The closure plan should include a description of procedures used to decontaminate or dispose of the following:

- All transport and storage containers, tanks and ancillary facilities;
- All equipment, including that used for transport, landspreading, tilling, waste-mixing, and cleaning processes; and
- Cleaning wastes and residues from cleaning.

The owner or operator must include in the closure plan a description of procedures for cleaning all equipment and facilities, an estimate of the amount of residues resulting from cleaning (e.g., residues from the cleaning process, hazardous cleaning fluids, wastewaters, containers), and plans for their treatment, disposal or removal. This description may be relatively simple for the typical land treatment facility, if many of the land treatment facility's fixed facilites such as tanks or surface impoundments (for inventory storage and possible runoff water containment) have independent closure plans. If these facilities do not have independent closure plans, decontamination procedures must be described in the land treatment facility's closure plan.

The mobile equipment for spreading and mixing the waste with the soil would have to be decontaminated. The closure plan should include quantitative information about the amount of decontamination activity required and the estimated amounts of hazardous wastes resulting from the decontamination. The plan should include provisions for treating or disposing of residues. It is likely that many residues (e.g., wastewaters) may be disposed on the land treatment fields. The plan should include a description of the methods and quantity of wastes treated or disposed on- and off-site.

5.7 COVER AND VEGETATION

At the completion of the land treatment process, if there are still hazardous materials at the facility, an owner or operator may choose to stabilize the land treatment fields to control the migration of hazardous constituents rather than remove the contaminated soil. If the hazardous wastes are not removed, the owner or operator must also provide post-closure care.

In the closure plan, "the owner or operator must address the following objectives and indicate how they will be achieved:

(1) Control of the migration of hazardous waste and hazardous waste constituents from the treated wastes into the ground water;
(2) Control of the release of contaminated run-off from the facility into surface water;
(3) Control of the release of airborne particulate contaminants caused by wind erosion; and
(4) Compliance with §265.276 concerning the growth of food-chain crops."*

To meet these objectives without removing the contaminated wastes, an owner or operator may consider the use of cover materials, vegetation or other stabilizing methods to control migration of containments. In controlling the migration of pollutants, the Agency does not intend that all facilities be required to maintain a zero discharge; in some cases, some escape could be acceptable. The closure plan must include a description of the proposed measures based on the owner's or operator's assessment of the technical needs of his facility. For example, if at closure, inorganics or organics recalcitrant to biological breakdown still reamin on the land, a stabilizing vegetative cover would likely retard runoff flow and adequately prevent soil and wind erosion and migration of the wastes. In many cases, an elaborate clay cap, which may be appropriate for a landfill, will be unnecessary to meet these objectives. An owner or operator may choose to add an admixture to the zone of incorporation to fix contaminants from leaching instead of planting vegetation.

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*EPA Interim Status Standards, 40 CFR §265.280(a).

The discussion in the closure plan should include:

- The area of the facility that requires some form of control; and
- Characteristics of proposed control method.

5.7.1 Area of the Facility Requiring Cover and Vegetation

An owner or operator must include in the closure plan an estimate of the maximum area of the facility that will retain hazardous waste constituents after closure. The area may include areas in which treatment did not render the wastes completely non-hazardous, as well as areas designated for disposal of contaminated soils transferred from other portions of the facility to reduce the size of the area requiring containment. An owner or operator will likely be able to estimate the extent of the operation requiring some kind of containment at closure based on previous operating experience; that is, he will know which wastes are not rendered non-hazardous by land treatment.

5.7.2 Characteristics of Proposed Cover and Vegetation

In determining the applicability of various closure methods (e.g., final cover, admixture, diversion structures, runoff collection and treatment), an owner or operator will consider site-specific factors such as the wastes remaining in the soil, location, soil type, and depth to ground water. The closure plan will include a description of the proposed cover and vegetation which may include some of the following, if applicable:

- Type of soil used for a final cover;
- Design of cover;
- Type of vegetation planted;
- Total amount of materials required;
- Source of materials;
- Type of admixture used; and
- Diversion structures.

5.8 MONITORING OPERATIONS

The monitoring operations, i.e., unsaturated zone monitoring and ground-water monitoring, which are conducted during the active operation of the facility will be continued throughout the closure period until closure is certified by the professional engineer. The closure plan will include a description of the types of monitoring and the frequency of monitoring that will be conducted during closure. The monitoring program will likely be a continuation of that conducted during routine operation of the facility.

5.8.1 Soil Monitoring

The owner or operator of a land treatment facility is required to conduct a soil sampling program and "must have in writing, and must implement, an unsaturated zone monitoring plan."* This testing is of great importance because it monitors the effectiveness of the land treatment facility's containment of hazardous wastes and the progress of the decomposition process. A land treatment facility cannot be operated properly without a reliable program of soil testing. This soil testing program must be continued throughout the closure period. It will provide the measurement basis for discontinuing the closure period when the hazardous waste is decomposed.

The owner or operator should include in the closure plan a description of the monitoring to be conducted during the closure period based on his unsaturated zone monitoring plan, as required by §265.278. "The unsaturated zone monitoring plan must include, at a minimum:

(1) Soil monitoring using soil cores, and
(2) Soil-pore water monitoring using devices such as lysimeters."**

These samples are required to be taken below the depth at which the waste is incorporated into the soil. It is recommended that some soil tests be made in the mixed soil as well.

The frequency and location of these tests are determined on a site-specific basis based on variables such as waste application rates, soil permeability, and the proximity to the ground water. At some facilities, soil and soil-pore water sampling may be less frequent during the closure period than during the facility's active life, if no more wastes are being applied and monitoring during operations has indicated no contamination. When developing the closure plan, the owner or operator should use his judgment in describing an appropriate monitoring schedule and revise it if future operational experience deems it necessary.

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*EPA Interim Status Standards, 40 CFR §265.278(a).

**EPA Interim Status Standards, 40 CFR §265.278(b).

The closure plan should include:

- Details of the proposed monitoring (e.g., depth of monitoring, criteria and parameters of analyses);
- Frequency of sampling; and
- Maximum number of analyses required during the closure period.

5.8.2 Ground-Water Monitoring

Ground-water monitoring "must be carried out during the active life of the facility and for disposal facilities, during the post-closure care period as well."* Monitoring will be in accordance with the requirements specified in §265.90 et seq. of these regulations. A description of a monitoring program to be included in the closure plan would include:

- The types of analyses required during closure, i.e., from the date that final wastes are received until closure is certified by the professional engineer; and
- Maintenance that is required of the ground-water monitoring system to ensure that it is in working condition for the post-closure period, if post-closure care is required.

The simplest way to describe the monitoring to be performed during closure is to include a copy of the facility's ground-water sampling and analysis program. Since this program will not be implemented until one year after the effective date of these regulations, the Agency will be developing guidance for preparing monitoring plans. This document is not intended to provide guidance in this area; therefore, it is expected that, in developing the closure plan, an owner or operator will use his judgment in describing appropriate ground-water monitoring as required by §265.90 *et seq.* and revise the plan when more data and guidance become available. The closure plan should include a copy of the facility's ground-water sampling and analysis program when it is available.

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*EPA Interim Status Standards, 40 CFR §265.90.

Analyses Required During Closure

According to the ground-water monitoring regulations, samples collected to establish ground-water quality must be obtained and analyzed for the following parameters at least annually:

- chloride
- iron
- manganese
- phenols
- sodium
- sulfate

Samples collected to indicate ground-water contamination must be obtained and analyzed for the following parameters at least semi-annually:

- pH
- specific conductance
- total organic carbon
- total organic halogen

The closure plan should include the maximum number and the types of ground-water analyses required during the closure period. The number and types of sampling and analyses required during closure depend on the length of the closure period. For example, if one set of analyses are required annually and the others are required semi-annually, the owner or operator should allow in his plan the possibility that both sets of analyses will be required within the closure period, in order to make provisions for the maximum number of analyses. For this reason, the closure plan may include a schedule of more analyses than actually will be needed during closure.

Maintenance

If post-closure care is required, the closure plan will also include a description of the maintenance activities necessary to ensure that the ground-water monitoring system is in working condition for the post-closure period, which may include replacing or redrilling well, replacing seals and caps, pumps, etc., and required general maintenance. Since ground-water monitoring during closure is a continuation of monitoring performed during facility operations, most of this information will be based on past operating experience.

5.9 CLOSURE CERTIFICATION

"When closure is completed, the owner or operator must submit to the Regional Administrator certification both by the owner or operator and by an independent registered professional engineer that the facility has been closed in accordance with the specifications in the approved closure plan."*

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*EPA Interim Status Standards, 40 CFR §265.115.

An independent professional engineer is required to certify that closure activities were performed in accordance with the approved closure plan. It is not expected that an engineer will perform detailed tests. The owner or operator will include in the closure plan an estimate of the number of periodic inspections to be made by an engineer. The plan need not include the name and state professional engineer license number of the engineer, although this will be required later as documentation.

5.10 FOOD CHAIN CROPS

"During the post-closure care period, the owner or operator of a land treatment facility must assure that growth of food chain crops complies with §265.276."*

The regulations state that during post-closure an owner or operator must comply with the same regulations as during operation regarding the growth of food chain crops. For the purposes of this document, it is assumed that the owner or operator will continue to follow the same policies as during operation.

5.11 INSTALLING OR MAINTAINING FENCES

At some facilities, it may be desirable to restrict access, in accordance with the security regulations, Subpart B, §265.14, even after the facility has been closed. Although this requirement is at the Regional Administrator's discretion, the owner or operator should use his judgment, considering factors such as facility location, surrounding land use, and types of wastes buried to decide whether to include a security provision in the plan. At facilities in which access will be restricted during the post-closure care period, an owner or operator will address either the maintenance of security equipment used during the active life of the facility or installation of appropriate security equipment. In most cases, this will likely mean that an owner or operator will install a fence or ensure that the existing fence is in good condition at the time of closure.

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*EPA Interim Status Standards, 40 CFR §265.280(d)(3).

If an owner or operator plans to install a fence at closure, the closure plan should state the area of the facility that will be enclosed by the fence, the type of materials to be used, and dimensions of the fence. If a fence is already installed at the facility, the plan will describe the types of repairs expected to be needed to ensure that it is in good condition when post-closure begins.

5.12 SAMPLE CLOSURE PLAN OUTLINE: LAND TREATMENT FACILITY

EPA Facility ID No. ______________________________

Owner's or Operator's Name ______________________________

Address & Phone No. ______________________________

Facility Address ______________________________

I. FACILITY CONDITIONS

  A. General information

    1. Facility size (acres)
    2. Topography of facility
    3. Soil type
    4. Storage facilities
      a. Type (pile, surface impoundment, etc.)
      b. Capacity of each type
    5. On-site facilities
      a. Waste disposal facilities (landfills, incinerators, etc.)
      b. Pretreatment facilities
      c. Facility capacity (by type of facility)
    6. Waste characterization (for each major type of waste landspread)
      a. Chemical composition
      b. Physical state
      c. Quantity
      d. Decomposition rate of each waste spread

  B. Maximum extent of operation

    1. Largest area ever spread with wastes over the life of the facility (acres)
    2. Largest area ever spread at one time
    3. Type of wastes requiring most extensive treatment

  C. Maximum amount of inventory ever on-site

  D. Inventory of equipment (e.g., spreaders, tillers, transport equipment)

E. Schedule of final closure (milestone chart)
    1. Final date wastes accepted
    2. Date all landspreading completed
    3. Final date all waste decomposition completed
    4. Final date facility decontaminated
    5. Final date all contaminated soil removed, if applicable
    6. Date final cover completed, if cover is applicable
    7. Final date vegetative cover planted, if applicable
    8. Date that treatment fields have been stabilized if applicable
    9. Final date closure completed
    10. Total time required to close the facility
    11. Justification if closure is longer than six months

II. INVENTORY DISPOSAL
  A. Maximum amount of wastes on-site
    1. Maximum amount of wastes in storage
    2. Maximum amount of wastes in pretreatment
  B. Pretreatment required prior to landspreading
    1. Quantity requiring pretreatment
    2. Pretreatment procedures
  C. Procedures for landspreading
    1. Application rate
      a. Approximate quantity of waste per application
      b. Approximate acreage covered per application
      c. Total acreage required for landspreading of all inventory
    2. Equipment and labor required
  D. Other disposal methods, besides landspreading
    1. Quantity disposed on-site but not in land treatment fields
      a. Method of disposal
    2. Quantity disposed off-site
      a. Method of disposal
      b. Approximate distance to disposer

E. Time required to complete landspreading of all wastes

III. MATERIAL IN TREATMENT

A. Maximum extent of operation
   1. Largest area ever spread with wastes over the life of the facility (acres)
   2. Largest area ever spread at one time
   3. Type of wastes requiring most extensive treatment and decomposition rate

B. Procedures required for materials in treatment
   1. Frequency of activities performed (e.g., tilling, waste-mixing)
   2. Equipment and labor required

C. Time schedule for decomposition of materials in treatment

IV. SOIL TESTING AND REMOVING CONTAMINATED SOIL

A. Soil testing performed
   1. Number of soil samples
   2. Criteria for determining if hazardous materials remain at closure

B. Hazardous wastes remaining, if applicable
   1. Name and characteristics of wastes
   2. Quantity of wastes

C. Quantity of hazardous soil to be removed, if applicable

D. Method of treatment or disposal
   1. On-site disposal
      a. Size of area of land treatment field designated as disposal area
      b. Size and location of landfill
   2. Off-site treatment or disposal
      a. Method of treatment or disposal
      b. Approximate distance to facility

V. DECONTAMINATING THE FACILITY

A. Area of facility with potential soil contamination (excluding land treatment fields)
1. List areas with potential contaminated soil
a. Number of soil samples, if necessary
b. Criteria for determining contamination
2. Estimated depth of soil requiring removal
3. Total amount of contaminated soil (cu. yd.)
a. Amount of contaminated soil treated or disposed on-site and method of treatment of disposal
b. Amount of contaminated soil removed off-site, if applicable
(1) Method of treatment or disposal
(2) Approximate distance to facility

B. All equipment and/or facilities (e.g., landspreading, tilling and transport equipment) requiring decontamination
1. Name each piece of equipment and/or storage facilities and procedures for cleaning (e.g., steam-cleaning, hydroblasting, etc.)
a. Owner or operator labor or contractor
b. Quantity of residues from cleaning
2. Treatment or disposal method for residues from decontamination (including wastewater and liquid wastes)
a. Quantity of residues
(1) Quantity treated or disposed on-site
(2) Method of treatment or disposal
b. Quantity removed off-site
(1) Method of treatment or disposal
(2) Approximate distance to TSDF

VI. WASTE CONTAINMENT SYSTEM (if no hazardous materials remain when treatment is completed or all contaminated soils have been removed, omit this section)

A. Total area requiring stabilization

B. Characteristics of contaminated system

  1. Final cover, if applicable

    a. Cover design

    b. Type of soil

    c. Depth of cover

    d. Characteristics of vegetation

    e. Total amount of material required

    f. Source of material

      (1) Quantity available on-site

      (2) Amount purchased off-site, if applicable

  2. Characteristics of admixture chosen, if applicable

    a. Quantity required

    b. Source of materials

  3. Diversion structure, if applicable

    a. Design

    b. Construction activities required

VII. MONITORING OPERATIONS

  A. Types of monitoring required during closure

    1. Soil monitoring

      a. Details of monitoring program

        (1) Distribution of sampling stations

        (2) Criteria and parameters of analyses

      b. Frequency of sampling

      c. Maximum number of analyses required during closure

    2. Ground-water monitoring

      a. Maximum number of ground-water quality analyses required during closure

      b. Maximum number of ground-water contamination analyses required during closure

      c. Details of ground-water monitoring program (include copy of ground-water sampling and analysis program when available)

B. Maintenance of monitoring equipment, if post-closure care required

   1. Number of ground-water wells requiring redrilling
   2. Number of ground-water wells requiring replacement
   3. Need for replacement parts to all monitoring systems (name parts, e.g., pumps, seals, caps)
   4. Required routine maintenance

VIII. CLOSURE CERTIFICATION

A. Approximate number or schedule of periodic inspections by certifying engineer

IX. FOOD CHAIN CROPS

A. Describe plans for compliance with §265.276.

X. INSTALLING OR MAINTAINING THE FENCE

A. If fence already exists at your facility, describe required maintenance at closure to ensure it is in good condition

B. If fence is to be installed

   1. Area to be enclosed
   2. Type of materials used
   3. Dimensions of fence

6.0 LANDFILLS: GUIDANCE FOR DEVELOPING CLOSURE PLANS

6.1 INTRODUCTION

The following material provides instruction for the EPA Regional Offices and the regulated community concerning the preparation of closure plans. The instructions are followed by a sample closure plan outline which illustrates the concepts and intentions of the plan. This document and the accompanying outline are intended merely as guidance and many parts of them may not be applicable to any given facility. This guidance is based on the assumption that the landfill has been operating properly, and that no special requirements will be necessary to ensure adequate closure. The purpose of this document is not to provide guidance for remedial measures but rather to provide assistance to owners or operators of well-operated facilities in developing closure plans. A general discussion of conceivable problems that might exist at some facilities and the kinds of remedial measures that might be needed is included in Chapter 9.0, "Closure and Post-Closure Activities Required at Some Disposal Facilities."

In preparing the closure and post-closure plans, the owner or operator must address how the facility will be closed "in a manner that (a) minimizes the need for further maintenance, and (b) controls, minimizes or eliminates, to the extent necessary to protect human health and the environment, post-closure escape of hazardous waste, hazardous waste constituents, leachate, contaminated rainfall, or waste decomposition products to the ground water, or surface waters, or to the atmosphere."*

The terms "human health," "environment" and "control" are all relative terms. In some cases, protection of human health and environment may mean no discharge, while in other cases, some escape may be acceptable. To meet these objectives, the owner or operator must develop, as part of his closure and post-closure plan, an adequate analysis of the effectiveness of the proposed closure and post-closure procedures.

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*EPA Interim Status Standards, 40 CFR §265.112(a).

The instructions and the outline are separated into the following major headings which, in most cases, correspond with the closure regulations applicable to landfills:

- Facility conditions
- Maintaining partially closed areas of an active facility
- Removing of inventory
- Decontaminating the facility
- Cover and vegetation
- Ground-water monitoring
- Closure certification
- Collecting, removing and treating leachate
- Gas collection
- Installing or maintaining fences

The closure plan for landfill facilities should include a general description of facility conditions and, at a minimum, a description of the activities required to comply with the following closure requirements:

- Treating, disposing or removing inventory
- Decontaminating the facility
- Controlling pollution migration
- Ground-water monitoring
- Closure certification

It is expected that the majority of facility owners or operators will also partially close portions of their facility as part of normal operations. In these cases, the closure plans will need to include a description of a maintenance program for these inactive portions. Some landfill operations will be outfitted with a leachate collection, removal and treatment system; if a facility had such a system installed and operating before the closure period, then the closure plan must include a description of the program assuming similar operating conditions as during facility operation. Similarly, if gas monitoring is installed at a landfill during operation, a plan for monitoring throughout the closure period should be included in the closure plan. An owner or operator must also include a description of any security measures (e.g., fence) deemed necessary to restrict access to the facility after closure.

6.2 FACILITY CONDITIONS

The primary purpose of this portion of the closure plan is to provide the Regional Offices with the information for an initial check of the adequacy of the closure plan. This section of the plan contains a description of the factors determining the conditions of the facility, including the largest area of the facility ever open at a given time which varies according to the partial closure schedule, the maximum amount of inventory ever on-site during operations, a description of equipment and facilities, and a complete schedule of closure activities. With this information readily available, an EPA inspector can quickly evaluate the closure plan using a visual inspection to confirm that facility conditions never exceed the specifications described in the first part of the closure plan.

6.2.1 General Information

General information that would be useful in a closure plan includes:

- Facility size;
- Description of liner if one exists at the facility (e.g., liner material);
- Description of underlying soil;
- Leachate collection system, i.e., state whether one is installed at the facility; and
- Copy of NPDES permit if the facility discharges through a point source to U.S. waters.

6.2.2 Partial Closure

The closure plan must include "a description of how and when the facility will be partially closed, if applicable, and ultimately closed."* An owner or operator does not have to perform partial closures during the life of the facility, although partial closures are desirable, to avoid potential pollution. If an owner or operator does intend to include partial closures as part of routine operating procedures, the closure plan must include a schedule of these activities and a description of:

- The size of the area partially closed;
- The frequency of partial closures;
- Proposed methods for partial closure including, where applicable, type of cover (e.g., type of soil used, depth of cover, soil permeability, slope, etc.);
- Source of cover materials (on-site, off-site or some combination); and
- Vegetation chosen for the area partially closed.

Partial closure, i.e., partial fulfillment of the closure requirements, includes any activity that reduces what must be done at final closure and will therefore reduce the estimate of the maximum extent of operation. It involves all or some of the following activities: final cover; vegetation; terracing; sloping; and maintenance throughout the life of the facility. It is obvious that if a portion of a well-operated landfill receives a final cover, vegetation, other types of control technologies, proper terracing and proper continual maintenance, little may need to be done to that portion at closure. Although not all partial closures involve such extensive activities, it is likely that a landfill owner or operator will perform some of these activities as part of routine operations which will reduce requirements at final closure. For example, it is common practice for a landfill owner or operator to cap cells as they are properly filled and plant grass on the area at a later date. If the cells have been properly partially closed, and the area is properly maintained until final closure, that area will only require vegetation at closure, assuming vegetation is necessary and had not previously been planted.

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*EPA Interim Status Standards, 40 CFR §265.112(a)(1).

The key factor about partial closure which must be made clear in the closure plan is that partial closure procedures (i.e., activities which reduce the requirements at final closure) must be in accordance with the closure requirements of §265.310 and consistent with the plans for final closure. For example, if an owner or operator fills a 1-acre cell and covers it with an inadequate cap which will either require reworking or replacement at the time of final closure, the closure plan must still account for all of the activities required to properly close this portion of the facility. Similarly, if the activities stipulated for final closure include a cap with 2 feet of clay with a permeability of 10^{-7} cm/sec and 2 more feet of a more permeable material, the entire facility, including areas that have been partially closed, must have this kind of cover.

6.2.3 Maximum Inventory

The owner or operator must include in the closure plan "an estimate of the maximum inventory of wastes in storage or in treatment at any given time during the life of the facility."* This estimate of the maximum amount of inventory ever expected over the life of the facility should enable an inspector to evaluate this portion of the plan based on a visual inspection of the facility.

6.2.4 Equipment and Facilities

The owner or operator should describe the kinds of equipment and facilities on-site (e.g., transport vehicles, excavation equipment, spreaders, etc.) to enable an inspector to evaluate quickly the proposed plans for facility decontamination.

6.2.5 Schedule of Activities

The closure plan must include "a schedule for final closure which must include, as a minimum, the anticipated date when wastes will no longer be received, the date when completion of final closure is anticipated, and intervening milestone dates which will allow tracking of the progress of closure. (For example, the expected date for completing treatment or disposal of waste inventory must be included, as must the planned date for removing any residual wastes from storage facilities and treatment processes.)"**

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*EPA Interim Status Standards, 40 CFR §265.112(a)(2).

**EPA Interim Status Standards, 40 CFR §265.112(a)(4).

The closure period begins with the final acceptance of waste and concludes when closure has been certified by the professional engineer.* The schedule of closure activities for a landfill must include:

- Final date wastes will be accepted;
- Date all wastes treated or disposed or sent off-site, including:
  - Date all on-site treatment completed,
  - Date all on-site disposal completed, and
  - Date all remaining inventory removed to an off-site facility;
- Final date facility decontaminated;
- Date final cover completed (this date is largely affected by the size of the area to be covered and climatic conditions which may halt construction activities);
- Final date vegetation planted or other material used to control erosion placed; the date to be listed here is the date that planting has been completed;
- Final date of closure, and the effective date of post-closure, which is the date that closure has been certified by the professional engineer;
- Total time required to close the facility; and
- Justification if closure will take longer than six months from the date of the final acceptance of wastes (§265.113(b)). If an owner or operator requires more than six months to complete closure, the closure plan must include a justification for an extension as well as

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*The final date of closure referred to here is the date that the closure technical requirements have been certified by the professional engineer. The final date of closure for purposes of the financial responsibility requirements is the date that the Regional Administrator releases the closure fund to the owner or operator. A discussion of the legal implications of closure certification is in Section 2.2.8.

proof that all steps have been taken to eliminate any significant threat to human health and the environment. A further discussion of closure schedules is in Section 2.2.6.

6.3 MAINTENANCE OF PARTIALLY CLOSED AREAS

If partial closures are performed in order to reduce the activities necessary at final closure, the owner or operator will need to justify why these areas will be in good condition at final closure and will not require additional work at closure. To ensure that they remain in good condition, these inactive portions should be properly maintained as part of the facility's routine operations to prevent water infiltration and runoff, to control soil and wind erosion, and to mitigate problems caused by subsidence. The closure plan includes a discussion of maintenance of partially closed areas until the entire facility has been ultimately closed. Although the maintenance activities are similar to post-closure care activities, the post-closure care plan does not apply until the entire facility has been closed.

The key elements of a maintenance program which must be described are (not all partial closures include all activities associated with final closure, e.g., not all partially closed areas have vegetation, so maintenance programs will vary):

- Visual inspections;
- Ground-water monitoring;
- Maintaining the cover and vegetation, if applicable; and
- Controlling erosion.

6.3.1 Visual Inspections

Visual inspections are the simplest component of maintaining closed portions of an active facility. Inspections should be made at periodic intervals and after all major storms to detect any signs of erosion or subsidence, to examine the condition of the cover and vegetation, if applicable, and to inspect the condition of ground-water monitoring equipment. The frequency of these inspections should be a function of the climate and topography of the facility.

6.3.2 Ground-water Monitoring

The ground-water monitoring of the partially closed portions of a facility will be part of the facility's routine ground-water monitoring program in accordance with the requirements of §265.90 et seq. of these regulations.

6.3.3 Maintaining the Cover and Vegetation

The closure plan must contain a description of how the cover of partially closed areas will be maintained, if applicable. These procedures may include:

- Preventing ponding;
- Maintaining slope and grade;
- Fertilizing schedule;
- Mowing schedule;
- Sprinkling schedule;
- Replanting schedule; and
- Controlling rodents and insects.

The amount of maintenance required will depend largely on the extent to which the soil and clay cover are protected against erosion damage by vegetation. Some facilities, especially in arid regions, may be covered with gravel to prevent erosion. Routine repairs of the cover and maintenance of the slope and grade may be needed to prevent ponding and drainage problems. If there is vegetation, it will require periodic applications of fertilizer and mulch and seed for bald spots. Mowing is recommended because it promotes the growth of desired vegetation and it blocks the growth of trees or shrubs which could penetrate the cover soil with their roots. If mowing is not performed, the facility must be inspected periodically, and any shrubs or trees that have the potential to penetrate the cover soil must be removed. Depending on the location of the facility (e.g., areas that experience periodic droughts), the vegetation also may require sprinkling. The closure plan must contain a description of the types and frequency of activities required to maintain the inactive portions at that particular facility. It is likely that areas not covered with vegetation will require more maintenance to protect them against erosion. It also may be necessary for owners or operators of some facilities to develop a program to protect the cover against burrowing rodents and insects. If needed, the plan will include a description of the type of program to be instituted (e.g., poisoning program, professional extermination).

6.3.4 Erosion Control

Maintenance is required for the upkeep of the drainage and diversion systems of the inactive areas. These drainage channels are usually earthen structures, and frequent repairs will likely be needed to prevent erosion. The closure plan will include a description and frequency of activities required to prevent erosion, given the type of cover, type of vegetation, if applicable, climate, location, etc. This will be particularly important for areas without a protective vegetative cover.

6.4 TREATING, DISPOSING OR REMOVING INVENTORY

An owner or operator of a landfill must include in the closure plan:

- An estimate of the maximum amount of inventory reasonably expected on-site over the life of the facility;
- Methods and procedures for treating, disposing, or removing all inventory, including residues from processing; and
- Time schedule.

6.4.1 Maximum Inventory

The closure plan must include "an estimate of the maximum inventory of wastes in storage or in treatment at any given time during the life of the facility."* Inventory includes all wastes in all stages of processing, including wastes in storage and residues from processing.

The estimate of inventory must be based on the maximum amount ever expected to be on-site over the life of the facility, assuming normal conditions. It should always be high enough to ensure that if an inspector came onto the facility, the amount of inventory would not exceed the estimate in the plan, assuming normal operating conditions.

Since accumulating inventory has often been the cause of severe environmental damage, an owner or operator should keep the amount of wastes in storage at a minimum. Requiring in the closure plan an estimate of the maximum inventory ever on-site alerts the Regional Administrator to a potential hazard if a visual inspection shows more wastes on-site than the plan indicated. If the amount of inventory on-site ever exceeds the estimate in the plan, the owner or operator must revise the plan to reflect actual conditions; however, if the owner or operator can justify to the Regional Administrator that the excess inventory is a result of unexpected operating contingencies and the original estimate of maximum inventory can be restored quickly, the

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*EPA Interim Status Standards, 40 CFR §265.112(a)(2).

Regional Administrator may not require the owner or operator to revise the plan. A further discussion of maximum inventory is in Section 2.2.4.

6.4.2 Methods and Procedures for Removing Inventory

The procedures to be followed for treating, disposing or removing inventory are very site-specific and depend largely on whether on-site or off-site disposal is used, the quantity of inventory, and methods of disposal. The choice of on-site or off-site disposal may vary according to the quantity and type of wastes involved and the operating conditions of the facility at the time of final closure. Since it is much cheaper to dispose of wastes on-site, it can be expected that most inventory will be disposed on-site according to normal operating procedures. The closure plan will include a description of the procedures necessary to complete the following activities:

- Operating the facility in a routine manner while disposing of all inventory to be disposed on-site, including all stages of construction and waste processing required prior to landfilling, if necessary; and
- Removing and transporting all inventory, for which disposing on-site in the normal manner is not feasible, to an operating permitted disposal facility or a facility operating under interim status.

Procedures for Disposing On-Site

It is expected that most, if not all, inventory will be disposed on-site. If inventory is to be disposed on-site, the closure plan must include an estimate of the amount of waste to be disposed on-site taking into account all residues from processing, if applicable. The plan will be based on the owner's or operator's estimate of the maximum number of drums and the maximum quantity of bulk waste and residues on hand at any time.

The plan will contain a discussion of the kinds of activities necessary to operate the facility in a routine manner for the complete disposal of all inventory to be disposed on-site. The type and quantity of wastes to be disposed will greatly affect the procedures followed. The type of wastes will affect the kind of pretreatment required prior to disposal (e.g., chemical fixation, volume reduction, waste segregation, detoxification/degradation, encapsulation) as well as the method for disposal (e.g., incompatible wastes may require special types of landfilling techniques). The quantity of waste that is disposed on-site will determine the number and size of trenches necessary and the extent of construction required if trenches have not previously been dug. The plan will therefore include plans for design and construction of the trench, if disposal areas have not been excavated and prepared prior to closure, and procedures required for landfilling the wastes. Again, it is assumed that procedures will be routine operations. The closure plan must also contain a description of any procedures that are required at closure that are not part of normal operating procedures.

Removing Wastes to an Off-Site TSDF

Although it is anticipated that most, if not all, inventory will be disposed on-site, there are circumstances when removal to an off-site TSDF may be required. For example, if an owner or operator accumulated a large amount of inventory because of equipment breakdowns, severe weather conditions, or other operating problems at closure, making it difficult or impossible to dispose of the inventory on-site within a time period acceptable to the Regional Administrator, removing some of the wastes to an off-site TSDF might be required. It is also possible that if an owner or operator had a small quantity of incompatible wastes to dispose, it might be more convenient to remove them off-site. The plan will include an estimate of the quantity of wastes to [illegible] removed to an off-site TSDF and the approximate distance to the off-site facility.

6.4.3 Time Schedule

Accumulating inventory over long periods of time has often been the cause of serious environmental damages; thus, the regulations restrict the amount of time allotted during closure for treating, disposing or removing all wastes:

> "Within 90 days after receiving the final volume of hazardous wastes, the owner or operator must treat all hazardous wastes in storage or in treatment, or remove them from the site, or dispose of them on-site, in accordance with the approved closure plan."*

The owner or operator should state in the plan how all of the inventory will be disposed within 90 days. This ensures that an owner or operator must always have either the capacity available to dispose of wastes quickly on-site or have made preparations for removing the waste to an off-site TSDF.

6.5 DECONTAMINATING THE FACILITY

The closure plan must include "a description of the steps needed to decontaminate facility equipment during closure."** According to the regulations, "when closure is completed, all facility equipment and structures must have been properly disposed of, or decontaminated by removing all hazardous waste and residues."* The closure plan should include a description of the cleaning, testing and/or disposing of all items so that no hazardous materials remain undisposed of on-site. This will include cleaning up or disposing of contaminated equipment, soils and residues. The degree of cleanup required at a given facility at the time of final closure will vary according to the owner's or operator's operating practices.

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*EPA Interim Status Standards, 40 CFR §265.113(a).

**EPA Interim Status Standards, 40 CFR §265.112(a)(3).

6.5.1 Decontaminating the Soil

The closure plan will include a list of all areas with potentially contaminated soil requiring removal and disposal, an estimate of the quantity of contaminated soil to be disposed, and a description of disposal methods. Cleaning up hazardous waste drips and spills will be part of routine operating practices. The residues included in the closure plan are those on the surrounding grounds as a result of closure operations and those not previously cleaned up (e.g., residues on dikes, storage areas, trenches, diversions, spill containment areas). Soil testing may or may not be necessary depending on the facility conditions; the owner or operator should state in the plan the criteria used to determine the amount of contaminated soil to be removed and disposed. An owner or operator will need to refer to Section 261 of these regulations, "Identification and Listing of Hazardous Wastes," for the criteria for identifying the characteristics of hazardous wastes.

The amount of contaminated soil which must be removed and disposed will be a major factor in determining whether disposal will be on- or off-site. If readily available disposal capacity is not available at the facility and the closure plan does not include plans to build an additional cell for disposal, the owner or operator must describe plans for removing the waste to an off-site TSDF.

6.5.2 Decontaminating the Equipment and Facility

The closure plan may include a description of procedures used to decontaminate or dispose of the following:

- All transport and storage containers, tanks and ancillary facilities;
- All equipment, including that used for transport, storage, treatment, disposal, earth-moving, and cleaning processes;
- Cleaning wastes and residues from cleaning; and
- Any remaining water on-site from rain or snow.

The owner or operator must include in the closure plan a description of procedures for cleaning all equipment and facilities, an estimate of the amount of residues resulting from cleaning (e.g., residues from the cleaning process, hazardous cleaning fluids, wastewaters, containers), and plans for their disposal or removal. If residues are to be disposed on-site, a trench for disposal must be available. For facilities at which it is common for water to accumulate as a result of rain or snow, the plan must provide for removing excess water at closure.

6.6 COVER AND VEGETATION

According to the regulations, "in the closure and post-closure plan under §265.118, the owner or operator must address the following objectives and indicate how they will be achieved:

(1) Control of pollutant migration from the facility via ground water, surface water, and air;

(2) Control of surface water infiltration, including prevention of pooling; and

(3) Prevention of erosion."*

An owner or operator of a landfill must demonstrate in the closure and post-closure plans that the post-closure escape of hazardous waste constituents to ground water, surface water or the atmosphere will be controlled in a manner so as not to pose a threat to human health and the environment. In addressing these objectives, the owner or operator must consider, at a minimum, the site location, topography and land use, climate, hydrogeological conditions and characteristics of the proposed final cover. The closure plan should include a description of the natural or synthetic liner system, final cover, and vegetation. The type of cover and vegetation required will vary on a site-specific basis depending on what is necessary to protect human health and the environment. In some cases, this protection may mean that no discharge is acceptable from a particular facility, while in other cases, some escape could be acceptable. For example, the level of discharge acceptable from a facility located near a drinking water source would be significantly less than from a facility that only discharges into a completely nonpotable water source.

It is expected that most well-operated facilities will require, at a minimum, a final cover and vegetation or other material to stabilize the cover to ensure adequate control. A general discussion of other kinds of control technologies that might be needed to adequately close a facility is in Section 9.0, "Closure and Post-Closure of Disposal Facilities Designed With Less Than Optimum Control Technology." The following sections include a general discussion of the needs associated with final cover and vegetation.

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*EPA Interim Status Standards, 40 CFR §265.310(a) and (b).

6.6.1 Final Cover

The final cover refers to the materials and surface contours used to cover the landfill at closure to control surface water infiltration and pollutant migration. In most cases, vegetation or some other material will be required to stabilize the final cover. The integrity of the final cover is an important closure requirement for a landfill. Since there are so many site-specific factors, the cover design may vary; the owner or operator, therefore, must describe in the closure plan the type of cover (e.g., material and final surface contours) most appropriate for that facility, taking into account the functions of the cover (e.g., infiltration control, erosion and run-off control and wind erosion control) and characteristics of the cover. The owner or operator will also need to demonstrate the adequacy of the particular cover chosen in meeting the objectives of the regulations. The description of the final cover in the closure plan should include:

- The area of the facility that requires a final cover;
- Characteristics of cover (e.g., type of soil, thickness, permeability);
- Cover design; and
- Prevention of ponding.

These site-specific specifications of the cover included in the closure plan also apply to all previous partial closures (see discussion of partial closures in Section 6.2.2).

Area of the Facility Requiring Final Cover

An owner or operator must include in the closure plan an estimate of the maximum area of the facility that will ever require a final cover. The area of the facility that requires a final cover at closure depends on the size of the areas that have been partially closed in accordance with the closure plan and the extent to which these inactive areas have been properly maintained. The closure plan is to include an estimate of the maximum area that could ever require cover at any time during the life of the facility. For example, if no more than 2 acres of a landfill are ever open at one time and all of the areas that have been partially closed require no reworking, the maximum area requiring a cover would be 2 acres. This estimate must always be high enough so that if an inspector came onto the facility, no area larger than the amount stated in the plan would ever require a cover; therefore, this estimate must also account for portions of the facility that will be open at closure for purposes of residue disposal, areas that had been partially closed and require some reworking, and areas that are inactive but still open because of operating problems (e.g., poor weather conditions halting construction).

Characteristics of Cover

In describing the characteristics of the final cover, the closure plan will include:

- The type(s) of material(s) used for the cover (e.g., density, porosity, permeability, compatibility with waste to ensure wastes will not corrode cover);
- The thickness of each material chosen;
- Total amount of material required, which is a function of the size of the area to be closed and depth of cover;
- Amount and type of soil additives, if applicable; and
- Source of materials.

It is likely that at most facilities the final cover will be of a material with low permeability to protect against surface water infiltration. This material may be compacted clay (e.g., soil with 10^{-7} cm/sec permeability) or may be a barrier membrane liner over a buffer layer of soil, depending on soil availability and the site-specific conditions of the facility. If vegetation is to be planted on the final cover to control erosion, a sufficiently thick topsoil layer capable of supporting vegetation will be required. In arid regions of the country, gravel may be preferable to vegetation for controlling erosion.

The materials to be used will depend on the types of soil available on-site as well as the conditions of the facility. Since purchasing soil off-site is costly, it is likely that most owners or operators will use soil available on-site, if at all possible, for the final cover, i.e., the layer with low permeability and the layer capable of supporting vegetation, if applicable. It is possible to improve the quality of available soil by blending various soils, using soil additives, or making other provisions which would provide equivalent protection. For example, soil blending and synthetic additives may decrease the permeability of the on-site soil as well as make certain soils more capable of supporting vegetation. In addition to improving the quality of available soil, the Agency anticipates that many owners or operators may use membrane liners protected above and below by buffer soil layers instead of compacted clay for a cover of low permeability. These membrane liners may be cost-effective if adequate on-site soil material is unavailable or an acceptable degree of compaction is not possible at a particular facility, given the wastes disposed or facility conditions.

If the owner or operator intends to use soil available on-site for the final cover, he should state in the plan whether the soil has previously been excavated and stockpiled or whether excavation will be required at closure. The hauling distance of the soil should also be included. The plan will include an estimate of the quantity of materials to be purchased off-site, if applicable. If a membrane liner is to be used, the owner or operator should state the type of liner to be used and describe the sub-base preparation and the protective cover of the liner in the closure plan.

Cover Design

The closure plan shall contain descriptions of the proposed grading and terracing for purposes of erosion control. The description will include:

- Slope of cover which must be great enough to prevent water pooling but not encourage erosion;
- Length of run of slope; and
- Drainage and diversion structures to channel water away from the waste area.

The owner or operator should also state whether a contractor or the owner or operator will do the earthwork activities and whether the necessary equipment is available on-site.

6.6.2 Vegetation

Most landfills will require good vegetation to stabilize slopes and retard runoff flow, thus providing effective erosion control and minimizing the need for further maintenance. Other materials besides vegetation may be used for this purpose; for example, facilities located in very arid regions may use a gravel layer to stabilize the cover soil. In describing the vegetation to be used, the owner or operator should include in the closure plan:

- Surface area requiring vegetation or other stabilizing material;
- Characteristics of vegetation to be planted, if applicable;
- Soil preparation procedures, if applicable; and
- Description of alternative stabilizing cover if vegetation will not be planted.

If vegetation is to be planted, the closure plan need only include provisions for planting once during the closure period. Any necessary replanting will be carried out during the early years of the post-closure care period and will be discussed in the post-closure plan.

Surface Area Requiring Vegetation or Other Stabilizing Material

The estimate of the area requiring vegetation or other stabilizing material at closure will be the maximum amount ever required during the life of the facility, including:

- Area of the facility being closed at closure;
- Area of the facility that was capped as part of partial closure but was not vegetated, if applicable; and
- Area of the facility that was previously vegetated but requires some replanting.

Characteristics of Vegetation

The type of vegetation chosen to prevent erosion and minimize the need for further maintenance will vary according to the type of soil used for the final cover (e.g., depth, nutrients, pH, moisture), climate, amount of rainfall, and other site-specific factors. Information that would be helpful in the closure plan includes the type of vegetation chosen; climatic, soil, and maintenance requirements (e.g., temperature, rainfall, nutrients, pH, depth and moisture of soil, frequency of replanting, watering, fertilizing); and the depth of the root structure to ensure that the roots could not penetrate through the cover into the buried wastes.

Soil Preparation Procedures

A description of soil preparation activities may include:

- Type and quantity of fertilizer required;
- Quantity of seed required;
- Type and quantity of mulch required; and
- Procedures for soil preparation (e.g., disking).

If an alternative to vegetation is to be used, the closure plan should include the type and quantity of materials to be used and an explanation of how it will protect the integrity of the cover. The owner or operator should state whether or not a contractor will be responsible for planting the vegetation or an alternative cover. If planting vegetation has been part of partial closure procedures, much of this information will be known from operating experience.

6.7 GROUND-WATER MONITORING

Ground-water monitoring "must be carried out during the active life of the facility, and for disposal facilities, during the post-closure care period as well."* Monitoring will be performed in accordance with the requirements specified in §265.90 et seq. of these regulations. It is expected that the monitoring program carried out during closure and post-closure will be similar to that conducted during facility operations. A description of a monitoring program to be included in the closure plan would include:

- The types of analyses required during closure, i.e., from the date that final wastes are received until closure is certified by the professional engineer, assuming the manner and frequency as required during operation; and

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*EPA Interim Status Standards, 40 CFR §265.90(b).

- Maintenance that is required of the ground-water monitoring system to ensure that it is in working condition for the post-closure period.

The simplest way to describe the monitoring to be performed during closure is to include a copy of the facility's ground-water sampling and analysis program. Since this program will not be implemented until one year after the effective date of these regulations, the Agency will be developing guidance for preparing monitoring plans. This document is not intended to provide guidance in this area; therefore, it is expected that, in developing the closure plan, an owner or operator will use his judgment in describing appropriate ground-water monitoring as required by §265.90 et seq. and revise the plan when more data and guidance become available. The closure plan should include a copy of the facility's ground-water sampling and analysis program when it is available.

6.7.1 Analyses Required During Closure

According to the ground-water monitoring regulations, samples collected to establish ground-water quality must be obtained and analyzed for the following parameters at least annually:

- chloride
- iron
- manganese
- phenols
- sodium
- sulfate

Samples collected to indicate ground-water contamination must be obtained and analyzed for the following parameters at least semi-annually:

- pH
- specific conductance
- total organic carbon
- total organic halogen

The closure plan should include the maximum number and the types of ground-water analyses required during the closure period. The number and types of sampling and analyses required during closure depend on the length of the closure period. For example, if one set of analyses are required annually and the others are required semi-annually, the owner or operator should allow in his plan for the possibility that both sets of analyses will be required within the closure period, in order to make provisions for the maximum number of analyses. For this reason, the closure plan may include a schedule of more analyses than actually will be needed during closure.

6.7.2 Maintenance

The closure plan will also include a description of maintenance activities necessary to ensure that the ground-water monitoring system is in working condition for the post-closure period, which may include replacing or redrilling wells, replacing seals and caps, pumps, etc., and required general maintenance. Since ground-water monitoring during closure is merely a continuation of monitoring performed during facility operations, most of this information will be based on past operating experience.

6.8 CLOSURE CERTIFICATION

"When closure is completed, the owner or operator must submit to the Regional Administrator certification both by the owner or operator and by an independent registered professional engineer that the facility

has been closed in accordance with the specifications in the approved closure plan."*

An independent professional engineer is required to certify that closure activities were performed in accordance with the approved closure plan. It is not expected that an engineer will perform detailed tests. The owner or operator will include in the closure plan an estimate of the number of periodic inspections to be made by an engineer. The plan need not include the name and state professional engineer license number of the engineer, although this will be required later as documentation.

6.9 REQUIREMENTS FOR SOME FACILITIES

Some facilities, because of their site-specific characteristics, e.g., facility design or location, may require additional activities at closure. These additional requirements include:

- Collecting, removing and treating leachate;
- Gas collection; and
- Installing or maintaining fences.

6.9.1 Collecting, Removing and Treating Leachate

If a system for collecting, removing and treating leachate is present at a landfill, the owner or operator must include plans for its operation during the closure period. Procedures will be similar to those during operation and include monitoring, collecting, removing, treating, and disposing of leachate. Since these procedures are only required at facilities that have such a system in place, it is expected that an owner or operator will continue to operate as he has done during facility life.

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*EPA Interim Status Standards, 40 CFR §265.115.

For facilities with such a system, a description of procedures might include:

- Procedures for collecting and pumping leachate (e.g., leachate may collect in a sump and be pumped to a holding tank or pond or collected by portable equipment such as a vacuum truck;
- Monitoring program;
- Approximate volume of leachate collected during closure which will be a function of the length of closure;
- Location and procedures for leachate treatment (including methods for storing, pretreating and treating, e.g., biological or physical-chemical treatment, evaporation, package treatment facility);
- The design objectives of the treatment chosen and all materials and equipment required;
- Procedures for treating and disposing of leachate (e.g., transport/pumping procedures, procedures for discharging, including NPDES permit number as required under the Clean Water Act, if applicable, or off-site services);
- Procedures for disposing or removing residuals from treatment (e.g., on-site or off-site); and
- Maintenance required during the closure period to ensure that the system is operating properly before post-closure begins, which may include:
    - Repairs to parts of the system,
    - Replacement and reinstallation of parts, and
    - Routine maintenance.

6.9.2 Gas Collection

If a gas collection system is required during operation, an owner or operator should include in the closure plan the monitoring procedures to be followed during the closure period. It can be assumed that monitoring will be similar to that required during operation, and the details can therefore be based on the owner's or operator's operating records. The closure plan will include:

- Procedures for collecting gas including:
  - Design objectives of system, and
  - Materials and equipment required;
- Details of monitoring required during closure which will be based on the length of the closure period, including the type and number of samples and analyses and whether analyses are done on- or off-site; and
- Maintenance required during the closure period to ensure that the system is operating properly before post-closure begins, which may include:
  - Repairs to parts of the system,
  - Replacement and reinstallation of parts, and
  - Routine maintenace.

6.9.3 Installing or Maintaining Fences

At some facilities, it may be desirable to restrict access, in accordance with the security regulations, Subpart B, §265.14, even after the facility has been closed. Although this requirement is at the Regional Administrator's discretion, the owner or operator should use his own judgment, considering factors such as facility location, surrounding land use and types of wastes buried, to decide whether to include a security provision in the plan. At facilities in which access will be restricted during the post-closure care period, an owner or operator will address either the maintenance of security equipment used during the active life of the facility or installation of appropriate security equipment. In most cases, this will likely mean that an owner or operator will install a fence or ensure that the existing fence is in good condition at the time of closure.

If an owner or operator plans to install a fence at closure, the closure plan should state the area of the facility that will be enclosed by the fence, the type of materials to be used, and dimensions of the fence. If a fence is already installed at the facility, the plan will describe the types of repairs expected to be needed to ensure that it is in good condition when post-closure begins.

6.10 SAMPLE CLOSURE PLAN OUTLINE: LANDFILLS

EPA Facility ID No. ______________________________

Owner's or Operator's Name ______________________________

Address & Phone No. ______________________________

Facility Address ______________________________

I. FACILITY CONDITIONS
  A. General information
    1. Size of facility (acres)
    2. Description of liner, if applicable
    3. Do you have a leachate collection system?
    4. Copy of NPDES water pollution control permit if discharge through a point source to U.S. waters
  B. Schedule of partial closures, if applicable (milestone chart)
    1. Size of each area partially closed
    2. Type of cover
    3. Source of cover materials
    4. Vegetation
  C. Maximum amount of inventory ever on-site in any stage of processing
    1. Maximum number of drums
    2. Maximum amount of wastes in any stage of processing
    3. Other inventory
  D. Inventory of auxiliary equipment (e.g., excavation machinery, spreaders, bulldozers, etc.)
  E. Schedule of final closure (milestone chart)
    1. Final date of wastes accepted
    2. Dates for treating, disposing, or removing all wastes (including intervening milestones)
      a. Date all preprocessing completed
      b. Date all on-site disposal completed
      c. Date that all inventory has either been disposed on-site or removed to an off-site TSDF
    3. Final date facility decontaminated

        4. Date final cover completed
        5. Final date vegetation planted or other material placed
        6. Final date closure completed
        7. Total time required to close the facility
        8. Justification if closure is longer than six months

II. MAINTENANCE OF PARTIALLY CLOSED AREAS OF AN ACTIVE FACILITY

    A. Inspection frequencies
    B. Ground-water monitoring specifications if different from active portion of the facility (include any appropriate amendments to ground-water sampling and analysis plan)
    C. Cover maintenance
        1. Fertilization rate
        2. Replanting frequency
        3. Mowing frequency
        4. Sprinkling rate and frequency
        5. Rodent and insect control program
    D. Erosion control program
        1. Maintenance program for drainage and diversion systems
        2. Activities required to repair expected erosive damage

III. TREATING, DISPOSING OR REMOVING ALL INVENTORY

    A. Maximum volume of waste on-site in any stage of processing
        1. Total amount of wastes in drums and number of drums
        2. Volume of bulk wastes in any stage of processing (including storage) (yd^3)
        3. Total amount of residues from processing
    B. Total volume of waste to be landfilled on-site (yd^3)
        1. Quantity of waste already in drums (yd^3) and number of drums
        2. Amount of bulk waste (i.e., not contained) (yd^3) to be disposed after all treatment has been completed
        3. Total quantity of waste disposed on-site (including waste in drums, all waste that required treatment, and residues from treatment)

- C. Describe procedures for disposing of inventory on-site
  - 1. Amount of waste requiring pretreatment (yd^3)
    - a. Describe each treatment process required and the amount of waste requiring each treatment process
      - (1) For each process, include:
        - (a) Equipment (on-site availability)
        - (b) Materials needed
  - 2. Size of area, or number of cells and size of cell necessary for disposing of inventory (including site map of disposal area)
    - a. Construction required for landfilling if not completed before closure (e.g., design and construction of cell, excavation, lining, etc.)
  - 3. Procedures for landfilling (including procedures for disposing containerized and bulk wastes)
    - a. Types of equipment required
    - b. Availability (on-site or rental)
    - c. Materials required (e.g., soil for layering barrels)
      - (1) Quantity
      - (2) Availability
- D. Total volume of waste removed off-site (number of barrels; volume of containerized wastes)
  - 1. Method of off-site treatment or disposal
  - 2. Approximate distance to off-site TSDF

IV. DECONTAMINATING THE FACILITY

- A. Area of facility with potential soil contamination (sq. yd.)
  - 1. List areas with potential contaminated soil
    - a. Number of soil samples, if necessary
    - b. Criteria for determining contamination
  - 2. Estimated depth of soil requiring removal
  - 3. Total amount of contaminated soil (cu. yd.)
    - a. Amount of contaminated soil disposed on-site
    - b. Amount of contaminated soil disposed off-site

B. All equipment and/or facilities (e.g., tank, earth-moving equipment, piping and containers) requiring decontamination
  1. Name each piece of equipment and/or storage facilities and procedures for cleaning (e.g., steam cleaning, hydroblasting, etc.)
    a. Owner or operator labor or contractor
    b. Quantity of residues from cleaning
  2. Number of containers requiring disposal or decontamination
    a. Method of cleaning and/or disposing of containers
    b. Volume of residues
  3. Method for treating or disposing of residues from decontamination (including wastewater and liquid wastes)
    a. Quantity disposed on-site
      (1) Is trench available for residues?
      (2) If plan to dig a small trench, give size, location, design
      (3) Plans for disposing of liquid waste
    b. Quantity removed to an off-site TSDF
  4. Estimated amount of water on-site requiring removal (e.g., snow and rain accumulation)
    a. Methods for removal
    b. Source of disposal (on-site versus off-site)
      (1) If on-site disposal area
        (a) Procedures

V. COVER AND VEGETATION

A. Final cover
  1. Total area to be covered (sq. yd.) (line a + line b)
    a. Area of facility not previously partially closed with appropriate cover
    b. Area of any portions of facility open for disposing of inventory and wastes from decontamination

2. Characteristics of final cover
    a. Type(s) of material(s) (e.g., soil of 10^{-7} cm/sec permeability)
    b. Depth of material(s)
    c. Total amount of material(s) required
    d. Amount and type of soil additives, if applicable
    e. Source of material(s)
        (1) Quantity available on-site
            (a) Excavation required
            (b) Approximate hauling distance
        (2) Amount purchased off-site
            (a) Approximate hauling distance
3. Final cover design
    a. Slope of cover
    b. Length of run of slope
    c. Type of drainage and diversion structures
4. Earth-moving procedures
    a. Contractor or owner or operator to lay cover?
    b. Equipment needed for hauling, spreading, grading, compacting
    c. Available on-site or rental?

B. Vegetation (if not planting vegetation, omit parts 1 through 3)
    1. Total area requiring vegetation (acres)
        a. Area receiving final cover which will have vegetation (acres)
        b. Area partially closed but never vegetated (acres)
        c. Area previously vegetated but requiring some replanting (acres)
        d. Percentage of total area assumed to require replanting during closure (%) (acres)
    2. Characteristics of vegetation
        a. Name or type of vegetation (e.g., rye grass)
        b. Climatic, soil and maintenance requirements (e.g., temperature, moisture and nutrients requirements, replanting frequency)

        - c. Root structure (expected penetration depth of roots)
    - 3. Soil preparation procedures
        - a. Type and quantity of fertilizer required per acre; total required
        - b. Quantity of seed required per acre; total required
        - c. Type and quantity of mulch required per acre; total required
        - d. Contractor labor or owner or operator labor?
    - 4. Procedures for controlling cover erosion if vegetation is not to be planted
        - a. Type and quantity of materials to be used
        - b. Justification for materials chosen

VI. GROUND-WATER MONITORING

- A. Analyses required during closure
    - 1. Maximum number of ground-water quality analyses required during closure
    - 2. Maximum number of ground-water contamination analyses required during closure
    - 3. Details of ground-water monitoring program (include copy of ground-water sampling and analysis program when available)
- B. Maintenance of monitoring equipment
    - 1. Number of wells requiring redrilling
    - 2. Number of wells requiring replacement
    - 3. Need for replacement parts to system (name parts, e.g., pumps, seals, caps)
    - 4. Required routine maintenance

VII. CLOSURE CERTIFICATION

- A. Approximate number or schedule (e.g., every two weeks) of periodic inspections expected by the certifying professional engineer

VIII. COLLECTING, REMOVING AND TREATING LEACHATE

If a leachate collection, treatment and removal system is installed at your facility, complete this section.

- A. Describe your leachate collection system (i.e., pumping and collecting procedures)
    - 1. Describe the monitoring system
    - 2. Estimated volume of leachate collected per month
- B. Describe leachate treatment process
    - 1. Is treatment on-site or off-site? If on-site treatment, describe process for treatment
        - a. Design objectives
        - b. Materials and equipment required
- C. Disposing of leachate
    - 1. If discharged to public waters, refer to water pollution control permit number in Section I - "Facility Conditions"
    - 2. If hauling off-site, distance to TSDF
    - 3. Disposing of residuals
        - a. Quantity of residuals
        - b. Characteristics
        - c. If disposed on-site, where? (include drawing of disposal area)
        - d. If off-site, distance to TSDF
- D. Maintaining equipment
    - 1. Repairs and replacements required
    - 2. Regular maintenance required over the duration of closure

IX. GAS COLLECTION

If a gas collection system is required at your facility, complete this section.

- A. Procedures for collecting gas
    - 1. Design objectives of system
    - 2. Materials and equipment required
- B. Monitoring requirements
    - 1. Type of monitoring samples
    - 2. Number of samples
    - 3. Type of analysis
    - 4. Where are analyses performed?
- C. Maintenance of monitoring equipment
    - 1. Repairs required during closure
    - 2. Replacements required during closure
    - 3. Routine maintenance required during the closure period

X. INSTALLING OR MAINTAINING THE FENCE

- A. If a fence already exists at your facility, describe required maintenance at closure to ensure it is in good condition
- B. If fence is to be installed:
    - 1. Area to be enclosed
    - 2. Type of materials used
    - 3. Dimensions of fence

7.0 INCINERATORS: GUIDANCE FOR DEVELOPING CLOSURE PLANS

7.1 INTRODUCTION

The following material provides detailed instruction for the EPA Regional Offices and the regulated community concerning the preparation of closure plans for the treatment of hazardous waste by incineration. The instructions are followed by a sample closure plan outline which illustrates the concepts and intentions of the plan. This document and the accompanying outline are intended merely as guidance; many parts of them may not be applicable to any given facility. The discussion of closure plans provided in this document is based on the assumption that the incinerator has been operating properly and that no special requirements will be necessary to ensure adequate closure. The purpose of this document is not to provide guidance for remedial measures but rather to provide guidance to owners or operators of well-operated facilities. The instructions and the closure plan outlined in this Section are separated into the following major headings which, in most cases, correspond with the closure regulations applicable to incinerators:

- Facility Conditions
- Removing Inventory
- Decontaminating the Facility
- Air Quality Monitoring
- Closure Certification

7.2 FACILITY CONDITIONS

The primary purpose of this portion of the closure plan is to provide the Regional Offices with the information for an initial check of the adequacy of the closure plan. This section of the plan includes a description of the factors determining the condition of the facility; that is, a description of the facility, a list of equipment, a characterization of the wastes currently stored, the maximum amount of inventory ever on-site during operations, and a complete schedule of closure activities. With this information readily available, an inspector can quickly evaluate the closure plan using a visual inspection to confirm that facility conditions never exceed the specifications described in the first part of the closure plan.

7.2.1 General Information

General information that would be useful in a closure plan includes:

- Facility size;
- Incinerator operating specifications (e.g., capacity, emission control system, etc.);
- Storage facilities (including all tanks, surface impoundments, drainage pits, etc.);
- Other treatment and disposal facilities on-site, if applicable; and
- Waste characterization.

7.2.2 Maximum Inventory

The owner or operator must include in the closure plan "an estimate of the maximum inventory of wastes in storage or in treatment at any given time during the life of the facility."* This estimate of the maximum amount of inventory ever expected over the life of the facility should enable an inspector to evaluate this portion of the plan based on a visual inspection of the facility.

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*EPA Interim Status Standards, 40 CFR §265.112(a)(2).

7.2.3 Equipment and Facilities

The owner or operator should list the kinds of equipment and facilities on-site to enable an inspector to evaluate quickly the proposed plans for decontaminating the facility.

7.2.4 Schedule of Activities

The closure plan must include "a schedule for final closure which must include, as a minimum, the anticipated date when wastes will no longer be received, the date when completion of final closure is anticipated, and intervening milestone dates which will allow tracking of the progress of closure. (For example, the expected date for completing treatment or disposal of waste inventory must be included, as must the planned date for removing any residual wastes from storage facilities and treatment processes.)"*

The closure period begins when the owner or operator accepts the final wastes and concludes when closure has been certified by a professional engineer.** The schedule of closure activities for an incinerator must include:

- Final date for accepting wastes;
- Final date for all pre-incineration processing and treatment;
- Final date for treating inventory;

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*EPA Interim Status Standards, 40 CFR §265.112(a)(4).

**The final date of closure referred to here is the date that the closure technical requirements have been certified by the professional engineer. The final date of closure for purposes of financial responsibility requirements is the date that the Regional Administrator releases the closure fund to the owner or operator. A discussion of the legal implications of closure certification is in Section 2.2.8.

- Final date facility decontaminated;
- Final date closure completed which is the date that closure has been certified by the professional engineer;
- Total time required to close the facility; and
- Justification if closure will take longer than six months from the date of the final acceptance of wastes (§265.113(a)). If an owner or operator must take longer than six months to complete closure, the closure plan must include a justification for an extension as well as proof that all steps have been taken to eliminate any significant threat to human health and the environment. A further discussion of closure schedules is in Section 2.2.6.

7.3 REMOVING INVENTORY

An owner or operator of an incinerator must include in the closure plan:

- An estimate of the maximum amount of inventory reasonably expected on-site over the life of the facility;
- Procedures for any necessary pretreatment;
- Methods and procedures for disposing, treating, or shipping off-site all inventory, including residues from processes; and
- Time schedule.

7.3.1 Maximum Amount of Inventory

The closure plan must include "an estimate of the maximum inventory of wastes in storage or in treatment at any given time during the life of the facility."* The term "inventory" includes all wastes in all stages of processing, including storage and residues from incineration processing. In most cases, removing all inventory should simply represent normal operating procedures.

The estimate of inventory must be based on the maximum amount that would ever likely be on-site during the life of the facility. It should always be high enough to ensure that if an inspector came onto the facility, the amount of inventory would not exceed the estimate in the plan, assuming normal operating conditions.

Since accumulating inventory has often been the cause of severe environmental damage, an owner or operator should keep the amount of wastes in storage at a minimum. Requiring in the closure plan an estimate of the maximum inventory ever on-site alerts the Regional Administrator of a potential hazard if a visual inspection shows more wastes than the plan indicated. If the amount of inventory on-site ever exceeds the estimate in the plan, the owner or operator must revise the plan to reflect actual conditions; however, if the owner or operator can justify to the Regional Administrator that the excess inventory is a result of unexpected operating contingencies and the original estimate of maximum inventory can be restored quickly, the Regional Administrator may not require the owner or operator to revise the plan. A further discussion of maximum inventory is in Section 2.2.4.

7.3.2 Pretreatment

The closure plan must include a description of all pre-incineration processing and treatment of inventory. Waste analyses and actual tests may be required if waste treatment processes not normally used will be necessary. The plan should also specify the quantity of wastes requiring pretreatment and the quantity resulting from pretreatment. The type of waste will affect the kind of treatment required prior to incineration, as well as the type and quantity of residues which will require disposal.

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*EPA Interim Status Standards, 40 CFR §265.112(a)(2).

7.3.3 Methods and Procedures for Treating Inventory

The procedures to be followed for treating inventory are site-specific and depend largely on whether on-site or off-site capabilities are available, the quantity of inventory, and methods of treatment or disposal. The choice of on-site or off-site treatment may vary according to the quantity and type of wastes to be treated and the operating conditions of the facility at the time of closure. The closure plan should include a description of the procedures necessary to complete the following activities:

- Operating the facility in a routine manner for the complete treatment of all inventory to be disposed on-site, including all stages of waste processing and treatment; and
- Removing and transporting all inventory for which on-site treatment is not feasible to an operating permitted facility or a facility operating under interim status.

On-Site Treatment

On-site treatment is clearly the most convenient and least expensive method of treating inventory. Most inventory will probably be treated on-site according to normal operating procedures. If inventory is to be treated on-site, the closure plan must include an estimate of the amount of waste to be treated on-site, taking into account all residues from processing, if applicable. The plan will also include an estimate of the maximum number of drums and the maximum quantity of bulk waste and residues on hand at any time.

The plan will include a discussion of the kinds of activities necessary to operate the facility in a routine manner for the processing and incineration of all inventory to be treated on-site. The type and quantity of wastes to be treated will greatly affect the procedures followed.

Removing Wastes to an Off-Site TSDF

Although it is anticipated that most inventory will be treated on-site, there are circumstances when wastes must be removed to an off-site TSDF. For example, if an owner or operator accumulated a large amount of inventory because equipment breakdowns made it difficult or impossible to treat it on-site within 90 days, removal to an off-site facility may be required. In addition, incinerator residues (e.g., ash) and residues generated by facility decontamination that cannot be incinerated will also need to be removed off-site if disposal facilities are not available on-site. If a permitted landfill or one with interim status is available on-site, the owner or operator should describe the landfill in the plan and estimate the quantity to be disposed. He also must provide post-closure care for the landfill. If the owner or operator removes wastes to an off-site TSDF, the plan will include an estimate of the quantity of wastes and the approximate distance to the off-site facility.

7.3.4 Time Schedule

Accumulating inventory over long periods of time has often been the cause of serious environmental damages; thus, the regulations restrict the amount of time allotted during closure for treating all wastes:

"Within 90 days after receiving the final volume of hazardous wastes, the owner or operator must treat all hazardous wastes in storage or in treatment, or remove them from the site, or dispose of them on-site, in accordance with the closure plan."*

The owner or operator should include an estimate of the time required to dispose of the maximum amount of waste expected over the life of the facility, which must be no greater than 90 days. The estimate of the time required to treat inventory should reflect normal operating capacity and not theoretical throughput. Thus, for example, if experience has shown that the incinerator normally functions only 50 percent of the time, this should be reflected in the planned closure schedule. Requiring all inventory to be treated within 90 days ensures that an owner or operator either restricts his inventory to what the incinerator can be expected to handle or has made preparations for removing the inventory off-site.

7.4 DECONTAMINATING THE FACILITY

The closure plan must include "a description of the steps needed to decontaminate facility equipment during closure."** According to the regulations, "At closure, the owner or operator must remove all hazardous waste and hazardous waste residues (including but not limited to ash, scrubber waters, and scrubber sludges) from the incinerator."*** The closure plan should include a description of the cleaning, testing and/or treating of all items so that no hazardous materials remain undisposed on-site. This will include cleaning up or disposing of contaminated equipment, soils and residues. The degree of cleanup required at a given facility at the time of final closure will vary according to the owner's or operator's operating practices.

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*EPA Interim Status Standards, 40 CFR §265.113(a).

**EPA Interim Status Standards, 40 CFR §265.112(a)(3).

***EPA Interim Status Standards, 40 CFR §265.351.

7.4.1 Decontaminating the Soil

The closure plan will include a list of all areas with potentially contaminated soil requiring removal and disposal, an estimate of the quantity of soil to be disposed, and a description of disposal methods. Residues will be likely on the surrounding grounds as a result of drips and spills or storage (e.g., residues around storage ponds, drainage pits, and spill containment areas). Soil testing may be necessary depending on the facility conditions; the owner or operator should state in the plan the criteria used to determine the amount of contaminated soil to be removed and disposed. An owner or operator will need to refer to the Section 261 of these regulations, "Identification and Listing of Hazardous Wastes," for the criteria identifying the characteristics of hazardous wastes.

The closure plan should include a description of the disposal methods for the contaminated soil. An owner or operator of an incinerator may remove the soil off-site because most incinerators are not equipped to deal with large quantities of contaminated soil and the incineration process of soil produces residues which would require disposal. An owner or operator may dispose of the soil on-site if the incinerator is part of a multiple process facility with a landfill on-site that has interim status or is permitted. The closure plan will include a description of plans to remove the soil off-site, or to dispose of the soil in a landfill.

7.4.2 Decontaminating the Equipment and Facility

The closure plan should include a description of procedures used to decontaminate or dispose of the following:

- All transport and storage containers, tanks, and ancillary facilities;
- Refractory liners;
- All equipment used preceding the incineration of wastes, such as waste feed systems, conveyors and containers;
- Piping, pumps, valves;
- Air pollution control equipment;
- Cleaning equipment; and
- Cleaning wastes and residues from cleaning.

The owner or operator must include in the closure plan a description of procedures for cleaning all equipment and facilities, an estimate of the amount of residues resulting from cleaning (e.g., residues on pollution control equipment, residues from the cleaning process, hazardous cleaning fluids, wastewaters, residue containers, etc.) and plans for their disposal. As discussed above, these residues will be either disposed off-site or on-site if a disposal area is available. The plan should include a description of how these residues will be properly disposed.

7.5 AIR QUALITY MONITORING

If inventory is incinerated on-site, the owner or operator must continue to practice all of the monitoring and inspections which are part of normal operating procedures. A description of these practices must be included in the closure plan.

7.6 CLOSURE CERTIFICATION

"When closure is completed, the owner or operator must submit to the Regional Administrator certification both by the owner or operator and by an independent registered professional engineer that the facility

has been closed in accordance with the specifications in the approved closure plan."*

An independent professional engineer is required to certify that closure activities were performed in accordance with the approved closure plan. It is not expected that an engineer will perform detailed tests. The owner or operator will include in the closure plan an estimate of the number of periodic inspections to be made by an engineer. The plan need not include the name and state professional engineer license number of the engineer, although this might be required later as documentation.

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*EPA Interim Status Standards, 40 CFR §265.115.

7.7 SAMPLE CLOSURE PLAN OUTLINE: INCINERATORS

EPA Facility I.D. No.______________________________________

Owner's or Operator's Name________________________________

Address & Phone No._______________________________________

Facility Address____

I. FACILITY CONDITIONS

- A. General information
  - 1. Size of facility
  - 2. Incinerator specifications
    - a. Capacity
    - b. Throughput
    - c. Emission control system
    - d. Estimated combustion efficiency
  - 3. Storage facilities
    - a. Type (e.g., bulk or drums)
    - b. Capacity/volume
  - 4. Other facilities on-site (if applicable)
    - a. Type (landfill, incinerator, surface impoundment, etc.)
    - b. Capacity
  - 5. Waste characterization (to be filled out for each waste in inventory [e.g., phenolic wastewater, scrubber sludge, etc.] including waste material at any stage of processing, and/or any residue generated by the normal processing of the waste before or during closure, including contaminated soil or containers).*
    - a. Chemical composition
    - b. Physical state (i.e., liquid, solid, gas or mixture)

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*NOTE: The Interim Status Standards note that "unless the owner or operator can demonstrate...that any solid waste removed from his incinerator is not a hazardous waste, the owner or operator becomes a generator of hazardous waste and must manage it in accordance with all applicable requirements of Parts 262, 263, and 265 of this Chapter" (§265.351) (emphasis added).

        c. Combustion temperature
        d. Quantity
    B. Maximum amount of inventory ever on-site in any stage of processing
    C. Inventory of auxiliary equipment
    D. Schedule of final closure (milestone chart)
        1. Final date wastes accepted
        2. Dates for completing the treatment of inventory
            a. Date all preprocessing completed
            b. Date all on-site incineration completed
            c. Date all wastes not incinerated on-site removed
                (1) Date wastes disposed on-site
                (2) Date wastes removed to an off-site TSDF
        3. Final date facility decontaminated
        4. Final date of completed closure
        5. Total time required to close the facility
        6. Justification if closure is longer than six months

II. REMOVING ALL INVENTORY (to be filled out for each type of waste in inventory, including waste material at any stage of processing and or any residue generated by the normal processing of the waste before or during closure, including contaminated soil or containers).*
    A. Maximum amount of waste on-site in any stage of processing
        1. Total amount of waste/residue in drums and number of drums
        2. Total amounts of waste/residue in bulk storage (e.g., tanks, hoppers, etc.) Include tag number or other means identification for each tank or hopper.
    B. Pretreatment

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*NOTE: The Interim Status Standards note that "unless the owner or operator can demonstrate...that any solid waste removed from his incinerator is not a hazardous waste, the owner or operator becomes a generator of hazardous waste and must manage it in accordance with all applicable requirements of Parts 262, 263, and 265 of this Chapter" (§265.351) (emphasis added).

1. Quantity requiring pretreatment
2. Pretreatment process (including chemicals necessary for pre-incineration treatment)
3. Total amount to be treated or disposed following pretreatment

C. Methods and procedures for treating, disposing or removing inventory
   1. Procedures for on-site incineration
      a. Quantity
      b. Auxiliary fuel requirements
   2. Procedures for on-site treatment or disposal of wastes not incinerated
      a. Quantity
      b. Method and procedures used
   3. Off-site removal
      a. Quantity
      b. Method of treatment or disposal
      c. Approximate distance to off-site TSDF

III. DECONTAMINATING THE FACILITY

A. Area of facility with potential soil contamination (sq. yd.)
   1. List areas with potential contaminated soil
      a. Number of soil samples, if necessary
      b. Criteria for determining contamination
   2. Estimated depth of soil requiring removal
   3. Total amount of contaminated soil (cu. yd.)
      a. Amount of contaminated soil disposed on-site
      b. Amount of contaminated soil removed off-site

B. All equipment and/or facilities requiring cleaning (e.g., refractory liner, tanks, surface impoundments, drainage pits, discharge control equipment, containers tank trucks)
   1. Name each piece of equipment and/or storage facilities and procedures for cleaning (e.g., steam-cleaning, hydro-blasting, etc.)
      a. Owner or operator labor or contractor

        - b. Quantity of residues from cleaning
    - 2. Disposal method for residues from decontamination (including wastewater and liquid wastes)
        - a. Quantity treated or disposed on-site and method and procedures used
        - b. Quantity removed to off-site TSDF, method of treatment or disposal, and approximate distance to TSDF

IV. AIR QUALITY MONITORING

- A. Description of air monitoring activities
- B. Inspection procedures

V. CLOSURE CERTIFICATION

- A. A schedule or estimate of the number of periodic inspections by the certifying engineer anticipated during closure.

8.0 MULTIPLE PROCESS FACILITIES:
GUIDANCE FOR DEVELOPING CLOSURE PLANS

8.1 INTRODUCTION

As is currently the practice in the industry, many hazardous waste facilities contain multiple process units. For example, an incineration operation may be operated in conjunction with an on-site landfill for disposing of solid residues from the incineration process. These residues may be classified as hazardous wastes, depending on the types of materials consumed in the incinerator. The on-site chemical waste landfill also could accept wastes from other off-site generators. Another example would be an industrial wastewater processing plant which precipitated heavy metals into a sludge which would be landfilled.

8.2 CLOSURE PLAN FORMULATION

Physical arrangement of multiple process waste facilities will vary greatly. Some facilities may be planned to segregate operations into designated areas which are planned to remain unchanged for the life of the facility; in fact, different portions of the facility may have different planned lifetimes. At facilities which include permanent disposal, e.g., landfills and some surface impoundments, plans may include the movement of processing and storage units so that maximum use can be made of the available area for disposal. For the former case, closure plans can be formulated for each distinct area or sub-site. In the latter case, the closure plan will have to be designed to integrate all closure activities. It would be impossible to enumerate all possible combinations of disposal process units, physical arrangements, and planned rearrangements; therefore, the closure plans will be required to be based on certain hypotheses covering normal operations (e.g., inventory disposal or treatment) and EPA's end-point objectives for TSDF facilities. The closure plans must, of course, include the closure procedures specified for each applicable treatment, storage or disposal facility contained in the multiple process unit. The closure plan should also be based on predesignated facility areas being planned for either waste repository status (i.e., requiring post-closure monitoring and a post-closure plan) or complete decontamination (i.e., left in a state such that no hazardous wastes remain in these areas). It is recognized that in the actual event of closure these designations could be revised.

8.3 SAMPLE FACILITY

As a hypothetical example of a multi-purpose facility closure plan, consider the following situation:

On a 250-acre site, hazardous waste operations consist of:

(1) Incineration of waste hydrocarbons containing some chlorinated species, wastewaters containing traces of phenols, and some sludges from wastewater treatment plants;

(2) Separation of hydrocarbons (for incineration) and precipitation of heavy metals from industrial wastewaters;

(3) Landfilling in secure trenches of hazardous wastes, including solid residues from the incinerator, heavy metal sludges from wastewater processing and other suitable wastes from off-site generators.

For this hypothetical example, it is assumed that the operator predesignates 200 acres for repository status (including any required buffer zones) and plans to construct a series of landfills in this area. The other 50 acres are to be decontaminated and returned to usable industrial real estate after closure. The incinerator with its associated equipment (scrubber, scrubber liquor storage lagoons, waste blending and storage tanks), the on-site laboratory, and the waste receiving facilities are assumed to be located on the 50 acres which are to be decontaminated at closure. The wastewater processing facility and its associated equipment (storage tanks, mixing tanks, clarifiers, filter presses for sludge dewatering) are initially placed on a portion of the 200 acres designated for repository status, with the intention of moving them to an area atop some completed landfills (after filling and capping but before final grading, covering and revegetating) to make way for later landfills.

The closure plan for this facility would consist of three parts:

(1) Closing the incinerator and decontaminating the 50 acres to be returned to industrial use (follow the Guidance for Developing Closure Plans for incinerators);

(2) Closing the wastewater processing plant and decontaminating and removing the associated equipment to the extent necessary for closure of the 200-acre waste repository area. For planning purposes, it would be reasonable to assume that the wastewater processing facilities have been moved to areas overlying capped landfills (apply facility decontamination instructions for impoundments or tanks to this case, making suitable adjustments for decontamination procedures unique to wastewater processing facilities);

(3) Closing the landfills, applying final cover, and revegetating disturbed areas in the 200-acre portion of the facility which was predesignated as a waste repository (follow the Guidance for Developing Closure Plans for landfills).

9.0 CLOSURE AND POST-CLOSURE ACTIVITIES REQUIRED AT SOME DISPOSAL FACILITIES

9.1 TYPES OF FACILITY PROBLEMS

In the early years following implementation of these regulations, some hazardous waste disposal facilities may close which were not designed with adequate technology and will require more extensive closure activities than previously discussed in Chapters 3 through 8 to ensure the protection of human health and the environment. This situation could arise from several causes, e.g.:

- The hydrogeology of the facility was not well understood at the time the facility was established;
- The waste being interred was originally thought to be non-hazardous but its classification has changed;
- The behavior of the waste in the disposal facility environment was not well understood;
- The design and/or construction of the control barriers was defective by current standards; or
- The location of the disposal facility was poorly chosen.

In some cases, prudence may dictate disinterment of the waste and reburial or other disposal using more modern technology. However, in the vast majority of cases, the best course will be to leave the wastes in place and apply closure procedures which will minimize the amount of hazardous waste material which may migrate from its burial position. Post-closure activities for such facilities must include contingency plans for problems which can be anticipated as well as adequate maintenance and surveillance. (Note: Random waste disposal or dumping grounds are not included in the category of facilities discussed here, e.g., "The Valley of the Drums.")

9.2 FACILITY CLOSURE

Closure activities for each facility will, of course, have to be tailored to the particular circumstances. However, certain general objectives can be stated:

- Control of pollution migration via ground water, surface water, and air environments;
- Minimization of leachate formations within the waste;
- Minimization of gas formation within the waste;
- Minimization of waste material mobility; and
- Protection of human health and the environment.

These objectives are, of course, also applicable to the design of new facilities; however, possible methods of accomplishment are more complex and indirect for facilities not originally planned with the best control technology currently available.

Control of surface water infiltration would include the use of a cover material of low permeability, surface drainage to minimize infiltration, vegetative cover to minimize erosion, etc. However, in some cases control of pollution via the ground water may require some more exotic measures. Obviously, the hydrogeology of the facility must first be understood as well as possible. This may require that borings be made around the buried wastes or, in some cases, into the buried wastes, if it is safe to do so. Indeed, in some cases the boundaries of waste burial may not be precisely known beforehand. Such borings should be made under competent supervision of hydrogeologists and coordinated with state and local water supply agencies. (Particular care must be taken against inadvertently penetrating aquicludes which are isolating the waste from ground-water aquifers.) Once the hydrology is understood, design of perimeter barriers to ground-water movements and ground-water diversion drains may be possible. In situations where movement of ground water is slow and the amount available is limited, selective pumping of ground water to influence gradients may be a useful technique. Construction techniques can include physical modification of the subsoil by excavation and replacement, e.g., digging a trench and refining it with low permeability compacted clay, or by injection of slurries of clays or soil modification chemicals into the subsoil.

Minimization of leachate formation in the buried wastes is accomplished in the first instance by limiting infiltration of ground and surface water into the wastes by the aforementioned means. If additional measures are required, consideration can be given to the injection of absorbants, if sufficient void space is known to exist, or to the injection of cementitious mixtures which hydrate with additional moisture upon hardening. Alternatively, sumps for removal of leachate by pumping may be possible, installed by drilling directly into the waste mass, if it is safe to do so, or using directional drilling techniques from the perimeter of the buried wastes.

Gas formation in buried wastes is so dependent on the particular mixture of waste interred that methods for its control, if found to be necessary, would be very particular to each case. Injections of pH control agents, such as lime, may be advisable to suppress or retard the rate of anticipated reactions between waste components. If large amounts of municipal wastes were co-disposed with the hazardous wastes, the generation of considerable methane and carbon dioxide can be anticipated. Installation of gas extraction wells, such as are used in sanitary landfills, may be necessary, although the nature of the hazardous wastes will have to be carefully considered beforehand; gas wells which are operated under negative pressure (i.e., evacuated by pumping) will tend to cause air to be drawn into the waste, which in some cases may have adverse effects.

Waste material mobility can sometimes be reduced by injection of chemical modifiers. An obvious case is pH control agents in waste containing heavy metals. Other possibilities include cementitious materials which can encapsulate wastes at the molecular level, and materials to promote polymerization of organic wastes. Again, the treatment, if necessary, would have to be tailored to the particular situation.

In some cases, future uses of the land may have to be more severely constrained to protect human health and the environment. For example, absolute security may have to be imposed using fencing and full-time security personnel. In most cases, such drastic measures will hopefully not be required, and the land can be returned to some productive use.

9.3 POST-CLOSURE

Monitoring of ground waters in the vicinity of the wastes and detection of leachate escape from the buried wastes, are, of course, even more necessary for facilities with less than adequate control design than for the best designed facilities. For facilities in which control of pollution via ground water has been provided by ex-post facto facility modifications, it is likely that there will be less confidence in the effectiveness of this control than for facilities designed and operated from the beginning with the best control technology. Therefore, it would be prudent to seek out water supply wells which could possibly be affected, even if the probability is small, and establish long-term surveillance programs for possible contamination. This will be particularly pertinent in areas of underlying bedrock aquifers; typically, water flow in such aquifers is controlled by small fissures and solution channels and is not uniform in all directions. It is possible that contamination of a well in such an aquifer could occur even though it is some distance away and no contamination is detected in the closure monitoring wells. Maintenance of drainage facilities, vegetative cover, leachate withdrawal and treatment systems (if necessary) and other facilities are, of course, required as described elsewhere in this document.

10.0 GUIDANCE FOR DEVELOPING POST-CLOSURE PLANS

10.1 INTRODUCTION

The following material provides instructions for the EPA Regional Offices and the regulated community concerning the preparation of post-closure plans which are required for disposal facilities. A discussion of other post-closure requirements, in addition to the preparation of post-closure plans, is provided in Section 12.3. The instructions are followed by an outline which will further illustrate the concepts and intentions of the plan. It should be noted that this document and the accompanying outline are intended merely as guidance and many parts of them may not be applicable to any given facility. This guidance is based on the assumption that the disposal facility has been adequately closed and that no special remedial measures will be required during post-closure to protect human health and the environment. The purpose of this document is not to provide guidance for remedial measures but rather to aid owners or operators in developing post-closure plans for facilities requiring routine kinds of post-closure care. A general discussion of conceivable problems that might occur and the kinds of post-closure activities that might be appropriate to protect human health and the environment is included in Section 9.0, "Closure and Post-Closure Activities Required at Some Disposal Facilities."

The instructions and the outline in this Section are separated into the following major headings which correspond with the post-closure regulations:

- Ground-water Monitoring
- Maintenance of Monitoring and Waste Containment Systems

Considerable site-to-site variation is expected that will require differences in the details of post-closure plans. The Agency does not require detailed engineering drawings or specifications in this document. The outline of a post-closure plan included in Section 10.5 illustrates some of the kinds of information that might be useful in preparing such a plan.

10.1.1 Facilities Requiring Post-Closure Care

A hazardous waste facility which is designed for the permanent disposal of hazardous waste is designated by EPA as a "disposal facility." According to the regulations, a disposal facility is "a facility or part of a facility at which hazardous waste is intentionally placed into or on any land or water, and at which waste will remain after closure"* (emphasis added). The post-closure care regulatory requirements apply to the "owners and operators of all disposal facilities."** This includes: hazardous waste landfills; surface impoundments in which hazardous wastes remain after closure (even if the owner or operator had originally planned to remove the hazardous wastes); land treatment facilities in which hazardous wastes are present at closure; any on-site disposal of hazardous wastes resulting from facility decontamination; and any other retention of hazardous wastes after the termination of the closure period.

10.1.2 Post-Closure Care Period

"The owner or operator of a disposal facility must provide post-closure care in accordance with the approved post-closure plan for at least 30 years after the date of completing closure."*** The interim status standards do, however, permit the Regional Administrator, on a site-specific basis, to entertain petitions for reducing or extending the post-closure period if deemed desirable or necessary to protect human health and the environment. See Section 13.3.7 for a discussion of the duration of the post-closure period.

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*EPA Interim Status Standards, 40 CFR §260.10(a)(15).

**EPA Interim Status Standards, 40 CFR §265.110(a).

***EPA Interim Status Standards, 40 CFR §265.117(d).

10.1.3 Frequencies of Monitoring and Maintenance

The post-closure plan must include provisions for the kinds of monitoring and maintenance activities which will be required annually as well as those required on an intermittent basis. For example, activities such as inspections may be monthly, especially in the early years of post-closure, to ensure the integrity of the cover and the control of erosion. Maintenance such as mowing and fertilizing may be required annually, while reseeding, mulching, monitoring well replacement and major repairs to the drainage channels will likely be needed less frequently.

10.2 GROUND-WATER MONITORING

The post-closure plan must include a description of "ground-water monitoring activities and frequencies as specified in Subpart F [Ground-Water Monitoring] for the post-closure period."* Ground-water monitoring "must be carried out during the active life of the facility, and for disposal facilities, during the post-closure care period as well."** Monitoring will be in accordance with the requirements specified in §265.90 et seq. A description of the monitoring to be performed annually during post-closure would include:

- The number and locations of the wells to be monitored;
- The frequency of the monitoring for the wells; and
- The types of analyses required.

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*EPA Interim Status Standards, 40 CFR §265.118(a)(1).

**EPA Interim Status Standards, 40 CFR §265.90(b).

The simplest way to describe the monitoring during the post-closure period is to include a copy of the facility's ground-water sampling and analysis program. Since this program will not be implemented until one year after the effective date of these regulations, the Agency will be developing guidance in this area; therefore, it is expected that in developing the post-closure plan, an owner or operator will use his judgment in describing appropriate ground-water monitoring as required by §265.90 et seq. and revise the plan when more data and guidance become available. The post-closure plan should include a copy of the facility's ground-water sampling and analysis program when it is available.

10.3 MAINTENANCE ACTIVITIES

The closure plan must include a description of all activities necessary to maintain the integrity of the cover and vegetation, the leachate and gas collection, treatment and removal systems, where applicable, and the function of the monitoring equipment. The post-closure plan should include maintenance provisions for any events that could reasonably be expected to occur over a 30-year period. For example, the owner or operator should include provisions for repairs of damage caused by storms, droughts, seismic activities, and subsidence if historical data or the owner's or operator's experience show that one or more of these natural events will likely occur within 30 years.

The significance of providing for such likely events is increased by the long duration of the post-closure period. It is possible that during the 30-year period surrounding land uses will change, important records may be lost, and key personnel with memories of the actual waste disposal practices will leave. Community changes and loss of the actual information about the facility will increase the probability of an accident resulting from inappropriate land use. As a result of the likelihood that there may be no one on-site full-time after a hazardous waste disposal facility has been closed, the post-closure plan should include the name and address of the person to be contacted in case of an emergency at the facility.

It should be noted, however, that it is not the intention of post-closure operations to establish the capability to handle extraordinary calamities such as a total liner failure brought about by a major earthquake. Such major catastrophic disasters are largely unpredictable and could cause a rupture at even the best hazardous waste facilities. Requiring each disposal facility to provide large amounts of money in anticipation of events of low probability is not an efficient way of solving this problem.

The post-closure plan should include a description and schedule of the following kinds of post-closure maintenance activities that will be needed at most facilities:

- Inspecting the facility;
- Maintaining the function and integrity of the final cover and/or vegetation; and
- Maintaining the ground-water monitoring systems.

10.3.1 Inspecting the Facility

The facility operator must make a periodic inspection of all of the facility systems that he is should maintain. These systems may include:

- Final cover;
- Drainage and diversion systems;
- Ground-water monitoring system;
- Surveyed benchmarks;

- Leachate collection system (if present on-site);
- Gas venting system (if present on-site); and
- Security systems (if required by the Regional Administrator).

The inspection of the condition of the cover and the drainage and diversion systems is particularly important because erosive damage can develop quite rapidly with little channels in the soil becoming large gullies. The employee making the inspection should carefully look for any signs of erosion that could lead to loss of cover soil or to the infiltration of runoff water into the waste cells. The frequency of this visual inspection should be a function of the viability of the ground cover. In addition, facilities that are prone to erosion due to their topography should have more frequent examinations. In general, facilities with grades of over 5 percent will suffer additional water erosion and facilities with large surfaces exposed to frequent winds of over 30 mph will have some wind erosion occurring.*

The regulations do not specify the frequency of the inspections that are to be conducted by the owner or operator. The primary guidance in this case should be good engineering practice and the operating experience at the particular facility. It is recommended that inspections be conducted after major rainstorms, as well as at periodic intervals, in order to quickly detect erosion events. Periodic inspections of the monitoring systems will alert the owner or operator if the systems are not functioning properly and prevent the possibility of undetected pollution. The benchmarks should be checked to be sure they have not been displaced. If an owner or operator is required to have a fence to restrict access to the facility, inspections will be necessary to ensure that the fence is in good condition.

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*R.J. Lutton, et al. Design and Construction of Covers for Solid Waste Landfills, U.S.E.P.A. - Municipal Environmental Research Laboratory, Cincinnati, Ohio, August 1979. EPA-60012-79-165.

10.3.2 Maintaining the Cover and/or Vegetation

The majority of the routine maintenance operations are directed at maintaining the integrity of the cover and vegetation and controlling erosion. The vegetation provides the primary protection for the soil and clay cover. This vegetation must be maintained for it to be an effective barrier against erosive damage. Facilities located in very arid regions may use a gravel layer over the cover soil instead of vegetation.

The post-closure plan must contain a description of the types and frequencies of activities required to maintain the integrity of the final cover and/or vegetation. A schedule of post-closure activities may include:

- Maintaining the cover;
- Mowing;
- Reseeding and mulching;
- Replacing soil;
- Fertilizing;
- Sprinkling; and
- Controlling rodents and insects.

If vegetation has not been planted, the post-closure plan should include a description of procedures necessary to maintain the stabilizing cover. Cover maintenance will include activities needed to repair damages to the cover caused by routine weather conditions as well as periodic natural events such as storms, droughts, frosts, seismic activity or subsidence. Rodent control measures, filling of rodent burrows, and applying insecticide will be required at some hazardous waste facilities during the post-closure period to counter major infestations. Based on current operating experience and historical records, an owner or operator should be able to include an estimate of the kinds of maintenance and repairs that might be necessary (e.g., repairs to cracks in the cover, pooling problems due to subsidence).

Almost all facilities with vegetative growth on the cover will need periodic mowing, reseeding and mulching of bald spots and eroded areas, replacement of soil lost to erosion, and the periodic application of fertilizer. Fertilizer applications can be expected to be more frequent in the early years of post-closure when the vegetation has not become firmly established. The other components (e.g., reseeding, mulching, replacing soil) may be acceptable at less than annual frequencies. Mowing is recommended because it promotes the growth of the desired vegetation and it blocks the growth of trees or shrubs which could penetrate the cover soil with their roots. If mowing is not performed, the facility must be inspected periodically and trees or shrubs that have the potential to penetrate the cover soil must be removed. At some facilities, the post-closure plan will need to include provisions for sprinkling during periods of drought and additional replanting if vegetation is severely damaged by droughts or storms which can be expected to occur within 30 years.

The level of detail in the description of procedures, frequency of activities and documentation included in the plan will vary according to the activity. For example, if fertilizer is to be applied to the vegetation, the approximate amount, type and frequency of the application should be specified. The EPA should encourage the owner or operator of the hazardous waste facility to seek the advice of the U.S. Department of Agriculture concerning the best practices for growing vegetation and controlling erosion.

Additional maintenance activities are required for the upkeep of the facility's drainage channels and culverts. This maintenance is important because these channels direct surface water runoff away from the disposal area where added surface water would infiltrate the soil and promote leaching. Since the drainage channels are usually earth structures designed for directing water flows, erosive damage will be a frequent occurrence requiring repairs. Related to this, drainage considerations will often require adding soil to a hazardous waste facility's surface sometime during the post-closure period. This building up of the soil would be especially important if subsidence has occurred at the landfill. Subsidence could change the desired 5 percent grade for general drainage to a depression, trapping surface water above the landfill's cover. The post-closure plan should include a description of the types and frequency of activities required to prevent erosion, given the type of cover, type of vegetation, climate, location, etc.

10.3.3 Maintenance of the Ground-water Monitoring System

The post-closure plan must include provisions for maintaining the ground-water monitoring system. Maintenance may include replacing or redrilling monitoring wells, replacing seals and caps, repairing or replacing pumps, and any other kinds of general equipment maintenance. Some of these activities will occur at irregular intervals during the post-closure period (e.g., well replacement).

The plan should include a schedule for these kinds of maintenance activities. Since ground-water monitoring during post-closure is a continuation of monitoring performed during facility operations, an owner or operator will gain experience over the life of the facility and be better able to predict future conditions and needs. It is intended that the owner or operator use his judgment when describing the maintenance program required for the ground-water monitoring system and revise the post-closure plan when more data become available.

10.4 ACTIVITIES REQUIRED AT SOME FACILITIES

The regulations do not require that disposal facilities have leachate collection, removal and treatment systems or gas collection systems. However, facilities which have a leachate collection and/or a gas collection system are required to monitor and maintain them throughout post-closure. In the post-closure plan, the owner or operator must include a description of the systems' operations. If the Regional Administrator has required that the facility owner or operator employ security measures or if the owner or operator thinks the Regional Administrator will require security measures (as allowed under §265.117(b) - Post-closure care and use of property; period of care and §265.14 - Security), the post-closure plan should also include a complete description of all security operations.

10.4.1 Leachate Collection, Removal and Treatment System: Maintenance and Operation

If a leachate collection, removal and treatment system is present at a hazardous waste facility, the owner or operator must include plans for its operation during the post-closure period. Procedures will be similar to those during operation and include monitoring, collecting, removing, treating and disposing leachate. If a facility has such a system, the owner or operator should include a description of procedures and a schedule to be following during the post-closure period which may include:

- Procedures for collecting and pumping leachate (e.g., leachate is generally collected in a sump and pumped out by means of a vacuum truck);
- Monitoring procedures;
- Procedures for leachate treatment;
- Procedures for disposing of leachate, including any residues from leachate treatment; and

- Maintenance required (e.g., piping replacement, repairs or replacement of sumps).

It is expected that an owner or operator will refer to operating records for these data.

10.4.2 Gas Collection System: Monitoring and Maintenance

If a gas collection system is required during operation, an owner or operator should include in the post-closure plan the monitoring and maintenance procedures to be followed during the post-closure care period. It can be assumed that monitoring will be similar to that required during operation, and the details can therefore be based on the owner's or operator's operating records.

The regulations do not specify the nature of this monitoring or the frequency of the tests. It is anticipated that the tests usually will be conducted with a "sniffer" mechanism held near to the vent pipe or by capturing the released gases in a balloon for subsequent laboratory analysis. The primary maintenance operations that will be needed will be the clearing of obstructions within the gas system and repairing damage to the system. The closure plan should contain a description of procedures and schedule to be followed during post-closure, and include:

- Procedures for collecting gas, including:
  - Design objectives of the system,
  - Materials and equipment required;
- Details of the monitoring program, including:
  - Types of samples,
  - Number of samples,
  - Types of analyses,
  - Frequency of analyses; and

- Maintenance required during the closure period to ensure that the system is operating properly before post-closure begins, which may include:
  - Repairs to parts of the system,
  - Replacement and reinstallation of parts, and
  - Routine maintenance.

10.4.3 Security System Maintenance

Some hazardous waste disposal facility owners or operators may be required by the Regional Administrator to maintain security devices (e.g., perimeter fences, warning signs) during the post-closure care period. Although this requirement is at the Regional Administrator's discretion, the owner or operator should use his own best judgment, considering factors such as facility location, surrounding land use, and types of wastes buried to decide whether to include a security provision in the plan. The post-closure plan should include a description of the maintenance required to ensure that the security system remains reliably functional throughout the post-closure period. For example, it is likely that a fence will require periodic repair and replacement of sections as a result of normal wear, severe weather conditions, and vandalism. The plan should also include an estimate of the frequency of the proposed maintenance activities. If the owner or operator does not intend to provide for security measures during the post-closure period, he should explain in the plan why such provisions are not required to ensure the protection of human health and the environment.

10.5 SAMPLE POST-CLOSURE PLAN OUTLINE

EPA Facility ID No. ______________________
Owner's or Operator's Name ______________________
Address & Phone No. ______________________
Facility Address ______________________
____

I. GROUND-WATER MONITORING (include copy of ground-water sampling and analysis program, when available)
  A. Number, location and depth of wells to be monitored during post-closure
  B. Frequency of monitoring of these wells
  C. Analyses required annually during post-closure
    1. Types of analyses required
    2. Procedures for monitoring and analyses

II. MAINTENANCE ACTIVITIES
  A. Facility inspections
    1. List all structures and facilities to be inspected
    2. Frequency of inspections for each
  B. Maintaining cover and/or vegetation
    1. Cover maintenance activities and schedule
    2. Mowing schedule
    3. Reseeding and mulching schedule
    4. Soil replacement
      a. Labor requirements
      b. Soil requirements
    5. Fertilizing schedule
    6. Sprinkling schedule
    7. Rodent and insect control program
  C. Controlling erosion
    1. Maintenance program for drainage and diversion system
      a. Anticipated labor requirements
      b. Anticipated soil requirements

2. Activities required to repair expected erosive damage
   a. Anticipated labor requirements
   b. Anticipated soil requirements
3. Replacement cover soil
   a. Amount to be stored on-site during the post-closure period
   b. Specification of alternative sources of cover soil, if applicable (i.e., off-site purchase agreement or on-site excavation)

B. Maintenance of ground-water monitoring system
   1. Number of wells requiring redrilling during the 30-year post-closure period
   2. Number of wells requiring replacement during the 30-year post-closure period
   3. Annual routine equipment maintenance (e.g., replacement of seals and caps, grouting)

C. Planned responses to probable occurrences (including those listed below)
   1. Loss of containment integrity
   2. Severe storm erosion
   3. Drainage failure
   4. Drought

IV. ACTIVITIES REQUIRED AT SOME FACILITIES

A. Collecting, removing and treating leachate

If a leachate collection, removal and treatment system is installed at your facility, complete this section

1. Describe your leachate collection system (i.e., pumping and collecting procedures)
   a. Describe the monitoring system
   b. Estimated volume of leachate collected per month
2. Describe leachate treatment process
   a. Is treatment on-site? If so, describe process for treatment

        - (3) Design objectives
        - (4) Materials and equipment required
  - 3. Disposing of leachate
    - a. If discharged to public waters, include copy of water pollution control permit
    - b. If hauling off-site, distance to disposer
    - c. Disposing of residuals
      - (1) Quantity of residuals
      - (2) Characteristics
      - (3) If disposed on-site, where? (include drawing of disposal area)
      - (4) If off-site, distance to disposer
  - 4. Maintaining equipment
    - a. Repairs and replacements required
    - b. Regular maintenance required

B. Gas Collection

If a gas collection system is required at your facility, complete this section

- 1. Monitoring requirements
  - a. Type of monitoring samples
  - b. Number of samples
  - c. Type of analysis
  - d. Frequency of analyses
  - e. Location of analyses (e.g., off-site laboratory analysis), if applicable
- 2. Maintenance of system
  - a. Anticipated frequency of repairs
  - b. Resource requirements (gravel, piping, etc.)
  - c. Regular maintenance required

C. Security and public access practices planned for the post-closure period

- 1. Description of security system
- 2. Maintenance schedule

11.0 REVISING CLOSURE AND POST-CLOSURE PLANS

11.1 REVISING CLOSURE PLANS

"The owner or operator may amend his closure plan at any time during the active life of the facility. (The active life of the facility is that period during which wastes are periodically received.) The owner or operator must amend his plan any time changes in operating plans or facility design affect the closure plan."*

Since closure plans must often be written up to 20 years ahead of the actual closure period, EPA expects that changes will occur during facility operation that will affect such plans. Additionally, the closure plans must account for the activities required to close the maximum extent of the operation ever open during the life of the facility, which in many instances requires the owner or operator to predict uncertain future operating conditions. For example, an owner or operator must account for the maximum area of a landfill ever open, including areas inactive but open because of operating problems, and must account for the most extensive amount of inventory. In some cases, predictions can be expected to be fairly accurate even over a 20-year period (e.g., size of the facility, length of operations) while others are much less predictable even over a somewhat shorter time frame (e.g., maximum inventory on-site).

Revisions may also be necessary if an owner or operator completely changes his plans for closing the facility. For example, if an owner or operator of a land treatment facility finds during the course of his operations that treatment is not completely successful, he must revise his plan to include provisions for removing all wastes or provisions for appropriate closure activities if the facility is to become a disposal facility, i.e., a facility at which wastes remain after closure. Similarly, if an owner or operator decides to remove all wastes from a surface impoundment instead of closing it like a disposal facility as originally proposed in the closure plan, major revisions would be required.

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*EPA Interim Status Standards, 40 CFR §265.112(4)(b).

The closure plan is the basis of the closure cost estimate and determines the extent of the financial responsibility requirements. It is therefore important to ensure that the plan is accurate and reflects the most extensive closure activities that are likely to be required over the life of the facility. The plan also serves as the basis for evaluating closure procedures when all closure activities have been completed. The professional engineer's certification, which is the final closure requirement, certifies that closure has been performed in accordance with the approved plan; therefore, the owner or operator must revise the closure plan during the closure period if changes in facility conditions affect the procedures described in the original closure plan. Any revisions to the approved closure plan that are needed must be approved by the Regional Administrator.

In preparing a closure plan, the owner or operator must describe the activities necessary to close the maximum extent of the operation unclosed at any time, assuming normal operating conditions. Revisions are required or may be desirable if the maximum extent of operation changes. Revisions may not be required if the maximum extent of operations changes because of unusual operating conditions. For example, an owner or operator is not expected to revise the plan to account for conditions caused by the 50-year flood or a liner failure unless such contingencies affect conditions at the time the plan is prepared. In the event of such unusual conditions, revisions may not be required if the owner or operator can justify to the Regional Administrator that the problems will be corrected and conditions, as described in the plan, will be restored within a short time. The closure plan must account for the effects of such unusual contingencies if they affect the conditions of the facility at the time the plan is prepared. A general rule is that the conditions at the facility at the time the plan is prepared should never exceed the specifications in the plan. If the closure plan must account for the effects of unusual operating problems, the owner or operator can later revise the plan to reflect the maximum extent of operations under routine operations, assuming normal operating conditions are restored.

The owner or operator should use his judgment in preparing the closure plan. The EPA will also be continuing to develop improved technical guidance to further assist the owners and operators in preparing closure and post-closure plans; therefore, the owner or operator will likely need to revise his plans as more guidance material and engineering data become available. For example, the Agency will be providing guidance material for a ground-water monitoring program which is to be implemented one year after the effective date of these regulations; therefore, an owner or operator will likely need to revise his original closure plan when these new data become available. Since many of the closure and post-closure activities are the same or similar to procedures practiced during operation, the owner or operator will also gain a better understanding as a result of experience and may need to revise his plan to reflect such knowledge.

The kinds of operating changes which might affect the closure plan and necessitate revisions include:

- Change in facility size and/or capacity;
- Changes in technology that may affect disposal or decontamination techniques, type of cover chosen, etc.;
- Changes in the closure schedule which alter the length of the closure period by greater than one month (e.g., severe weather conditions may halt construction activities and extend the closure period by more than one month);

- Changes in the schedule of periodic activities which affect activities required at closure (e.g., failure to partially close a facility would mean that a larger area than previously estimated would need to be closed at closure; the closure plan must always account for the maximum extent of the operation open at any time over the life of the facility);
- Changes in types or quantities of wastes that affect activities required at closure (e.g., the type and/or quantity of waste on-site at closure will affect the choices of treatment and disposal; the amount of waste taken off-site by an owner or operator of an incinerator depends on the types and quantities of residuals remaining after the wastes have been burned. The types and quantities of waste can also affect monitoring requirements and cover requirements);
- Change in maximum quantity of inventory ever expected on-site;
- Change in cover requirements from what was originally proposed;
- Changes in ground-water monitoring requirements as a result of an owner's or operator's operating experience during operation or modifications required by the Regional Office. The ground-water monitoring regulations stipulate that all or part of the requirements may be waived if there is a low potential for pollution and, conversely, that a more stringent plan must be implemented if the facility is affecting ground water (§265.90 and §265.93). Revisions will also be likely when the EPA provides more guidance and technical engineering data on the kinds of monitoring appropriate for hazardous waste facilities; and

- Operating contingencies during closure which may affect closure requirements (e.g., inclement weather causes construction problems; more contaminated soil must be disposed at closure than anticipated as a result of problems during operation).

11.2 REVISING POST-CLOSURE PLANS

"The owner or operator may amend his post-closure plan at any time during the active life of the disposal facility or during the post-closure care period. The owner or operator must amend his plan any time changes in operating plans or facility design affect his post-closure plan."*

The post-closure plan describes the monitoring and routine maintenance required to ensure the integrity of the cover and vegetation and monitoring systems. Since the post-closure plan is prepared while the facility is still in operation, it will likely be revised both during operation and during post-closure, if necessary, to reflect changes in facility conditions and operating experience. For example, if an owner or operator performs partial closures, he will need to maintain these areas and thus will gain experience in the kinds of maintenance activities needed during post-closure. Similarly, an owner or operator will be better able to describe the ground-water monitoring procedures after more EPA guidance becomes available and he gains operating experience.

The post-closure plan is the basis for the post-closure cost estimate which affects the extent of the financial responsibility requirements for post-closure. The plan therefore must be revised during facility operation, if necessary, to reflect the actual post-closure needs in order to ensure that adequate financial responsibility is required. In addition, the plan, together with the cost estimate, serves as the basis for post-closure reimbursements. The owner or operator will be reimbursed for post-closure costs, assuming that the activities were in accordance with the post-closure plan. Therefore, it is important for the owner or operator to revise the post-closure plan during post-closure if monitoring and maintenance requirements change during the period. Any revisions made during the post-closure period must be approved by the Regional Administrator.

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*EPA Interim Status Standards, 40 CFR §265.118(b).

Possible changes which could affect the post-closure plan include activities which are required on an annual basis as well as those required on an intermittent basis. Conditions which could affect the post-closure plan include:

- Change in facility size which will affect the extent of maintenance required;
- Changes in monitoring requirements as a result of an owner's or operator's operating experience during operation or modifications approved by the Regional Administrator (e.g., changes in the number of wells monitored and sampled, the frequency of analyses, types of analyses required). During the 30-year post-closure period, the owner or operator may petition the Regional Administrator to discontinue or alter the monitoring requirements; alternatively, under certain circumstances the Regional Administrator may require an owner or operator to continue monitoring beyond 30 years. Revisions will also be likely when the EPA provides more guidance and technical engineering data on the kinds of monitoring appropriate during post-closure;
- Changes in annual routine maintenance, including changes in the nature of the activities required and in their frequency (e.g., a more extensive erosion control program may be required than originally anticipated);

- Changes in activities required on an intermittent basis or changes in the frequency of these activities (e.g., an accelerated replanting schedule, more frequent replacement of wells than anticipated);
- Operating contingencies which occur during the life of the facility or post-closure which affect post-closure activities (e.g., severe weather conditions affecting activities required for erosion control, cover maintenance, maintenance of diversion structures);
- Changes in surrounding land use (e.g., if the population density increases, the measures needed to maintain facility security might change; ground-water monitoring program might be affected);
- Changes in monitoring and maintenance technology; and
- Modifications approved by the Regional Administrator; the owner or operator may petition the Regional Administrator to allow some or all of the requirements for post-closure to be discontinued or altered before the post-closure period is ended. Any such changes can only be made after the post-closure period begins and would constitute a revision to the post-closure plan made during post-closure.

12.0 ADEQUACY OF CLOSURE AND POST-CLOSURE PLANS

12.1 INTRODUCTION

Faced with the range of site-specific variables and the host of technical alternatives for satisfying the requirements of the regulations, the EPA has opted for determining the most specific technical measures on a case-by-case basis. No single engineering study can address or provide a comprehensive guide to all of the variables involved in this problem. Given the site-specificity of the requirements, evaluating the adequacy of the closure and post-closure plans is critical to ensure environmental protection.

The Regional Administrator has the critical role of evaluating technical procedures in approving closure and post-closure plans and should use his best judgment to determine the adequacy of closure and post-closure plans. Although the adequacy of the plans are ultimately determined by the Regional Administrator's judgment, there are some checks that do not require detailed engineering expertise. These checks may be useful during interim status as methods of determining quickly whether or not the closure and post-closure plans are reasonable and provide coverage for the activities that are obviously necessary. These checks can normally be accomplished with an hour or two on-site.

12.2 ADEQUACY OF SUBMITTED CLOSURE PLANS: CRITERIA FOR APPROVAL

The following discussion attempts to clarify and suggest possible ways to evaluate closure plans.

12.2.1 Inspecting the Facility

The first step in evaluating the closure plan is to visually inspect the facility and ensure that the conditions at the facility do not exceed the maximum conditions described in the first part of the closure plan. For example, an inspector could readily determine whether the number of drums and approximate amount of bulk waste on-site exceed the estimate in the closure plan. He could also see how much of the facility was open at the time, which would determine whether or not the owner or operator was complying with the operating schedule. An inspection would also provide the Regional official with a general idea about the extent of cleanup operations that would be required if the owner or operator were to commence closure.

12.2.2 Plans for Treating, Disposing or Removing Inventory

If an owner or operator includes a large estimate of inventory in the closure plan, the closure plan must include detailed provisions for its removal. Since accumulating inventory is often a major cause of large cleanup costs, it is essential that adequate procedures for disposing, treating, or removing the inventory to an off-site TSDF be specified in the closure plan. In estimating the maximum amount of inventory, the owner or operator should also include some estimate for residues. The plan must specify whether on-site or off-site treatment or disposal or some combination will be used to remove the inventory. If an owner or operator plans to treat or dispose of wastes on-site, the Regional official should check to be sure that:

- The plan includes the actual procedures to be used for disposing or treating inventory, including residues;
- There is available space on-site specifically designated for disposing or treating inventory;

- It is conceivable to dispose or treat the estimated amount of inventory on-site within 90 days;
- The facility accepts the kinds of wastes that are to be disposed or treated (e.g., an owner or operator of an incinerator might have certain hazardous residues which could not be landfilled at that multiple process facility and would need to be removed to an off-site TSDF);
- An owner or operator of a treatment or storage facility who proposes to dispose of wastes on-site has a facility with interim status or a permit; and
- The owner or operator has a post-closure plan if any wastes, including hazardous residues, are permanently disposed on-site.

12.2.3 Plans for Decontaminating the Facility

An evaluation of procedures for decontaminating a facility are site-specific and can best be judged with a visual inspection. Facility decontamination is not intended to be a highly complex technical requirement; rather, for a well-operated facility, it is intended to include routine cleaning procedures to ensure that all hazardous materials such as residues are removed from equipment and spills and drips are cleaned up. The proposed plans should always be extensive enough to cover all activities that might be needed if an owner or operator unexpectedly ceased operations and closed the facility. In most cases, a relatively small number of soil samples to determine the degree of contamination, accompanied by a visual inspection of the facility conditions, should be sufficient to evaluate the proposed plans for decontaminating the facility. An inspector should also check to ensure that the equipment on-site matches the list included in the closure plan. If, upon visual inspection, a facility appears to have a contamination problem, the Regional Administrator would be justified in demanding more detail in the closure plan, including provisions for soil tests, for example, to ensure that the owner or operator has made adequate plans for decontaminating the facility at closure.

The plan should also include provisions for treating, disposing or removing all hazardous residues, including contaminated soil, that result from the decontamination processes. If a facility is a permanent repository of waste or part of a multiple process facility with a disposal facility with interim status or a permit, it is likely that residues will be disposed on-site. If wastes are to be disposed on-site, the facility must have available capacity, and the plan should include a description of the procedures required for disposal. If a facility is not a permanent repository of waste, provisions must be made to remove the residues to an off-site TSDF.

12.2.4 Evaluation of Proposed Cover and Vegetation

All owners or operators of land disposal facilities, i.e., facilities at which wastes have been intentionally placed into land or water and will remain after closure, must provide cover and usually vegetation which will help to control, minimize or eliminate post-closure escape of hazardous waste constituents which could pose a threat to human health or the environment. The specifications are on a site-specific basis, and the adequacy of the system chosen must be demonstrated in the closure plan. The Regional Administrator must rely on his judgment and future EPA engineering guidance.

12.2.5 Monitoring Plans

The simplest way to evaluate ground-water monitoring procedures that are required during closure and/or post-closure is to ensure that the procedures are in accordance with §265.90 et seq. and that a copy of the ground-water sampling analysis plan has been included in the closure and post-closure plans. Until the ground-water program is implemented, it is expected that the owner or operator will use his own judgment in describing how he will comply with the ground-water monitoring requirements in Section 265.90 et seq. of these regulations. If a leachate collection, treatment and removal system or a gas collection system is in place at a facility, the plans should reflect a continuation of present operating procedures. A visual inspection of the facility's monitoring system could provide some idea of the adequacy of the proposed maintenance needs during closure and post-closure.

12.2.6 Closure Certification

An independent licensed professional engineer must certify that closure has been performed in accordance with the activities described in the closure plan. The Agency expects that certification will involve several periodic inspections during the closure period, and the Agency does not mean to imply that an engineer must be on-site throughout the entire closure period. The closure plan should include an estimate of the number of inspections anticipated.

12.3 ADEOUACY OF SUBMITTED POST-CLOSURE PLANS: CRITERIA FOR APPROVAL

The Regional Administrator has the authority to approve or disapprove post-closure plans that are submitted. This means that he should have established general criteria for this decision.

The primary criterion for post-closure plan adequacy is sound engineering judgment. Statements of an unusual or controversial nature in the post-closure plan should be supported by some type of justification or evidence. In many cases, the owner or operator can refer to his operating experience and records for documentation. For example, if an owner or operator performs partial closures as part of routine operating activities, he will have experience in many of the activities required during post-closure (e.g., mowing, fertilizing, controlling erosion).

In addition, the post-closure plan must contain some information on the monitoring and maintenance functions that are required by the regulations to be in the post-closure plan. This means that, at the very least, monitoring and maintenance operations must be discussed. The nature of the operations should be described and the planned frequencies of the operations given.

13.0 IMPLEMENTING CLOSURE AND POST-CLOSURE DURING INTERIM STATUS

13.1 PROCEDURES REQUIRED PRIOR TO CLOSURE ACTIVITIES

13.1.1 Submitting the Closure Plan

"The owner or operator must submit his closure plan to the Regional Administrator at least 180 days before the date he expects to begin closure. The Regional Administrator will modify, approve, or disapprove the plan within 90 days of receipt and after providing the owner or operator and the affected public (through a newspaper notice) the opportunity to submit written comments."*

An owner or operator who closes a hazardous waste facility during the interim status period must submit the closure plan to the Regional Administrator at least 180 days prior to the expected date of closure. The closure period begins when the owner or operator accepts the final wastes. An owner or operator is not allowed, under these regulations, to close without an approved closure plan. It is essential, therefore, that an owner or operator who closes during interim status has an adequate closure plan. If he does not have an acceptable plan, closure activities may be forestalled long after operations have ceased until an acceptable plan is developed. The purpose of this section is to discuss several problems that may emerge during the approval process and possible alternative approaches to avoid the above situation.

Upon receiving notification of pending closure, the Regional Administrator should send an inspector to the site to examine the facility and review the proposed closure procedures, allowing sufficient time to make modifications to the plan if deemed necessary. This is especially important if the plan has not been recently reviewed by the Regional Office. The Regional Administrator must approve, modify, or disapprove the plan within 90 days as well as notify the public that the facility will be closing and allow both the public and the owner or operator to submit written comments. The Regional Administrator must read all written comments and address them in a prepared statement.

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*EPA Interim Status Standards, 40 CFR §265.112(c).

During the interim status period, it is likely that the closure plan will require some modifications. Modifications may be necessary if:

- The Regional Administrator's judgment differs from the owner's or operator's judgment;
- Ground-water monitoring plans are inadequate;
- The owner or operator fails to revise the plan to reflect current conditions; or
- Unexpected operating problems make it necessary to alter the closure plan to meet the closure performance standards.

Assuming that the plan is modified in a manner acceptable to both the Regional Administrator and the owner or operator, the Regional Administrator will approve the plan and the owner or operator can begin closure procedures.

If the Regional Administrator finds the plan totally inadequate, he has three options: (1) disapprove the plan and require the owner or operator to submit a new one for approval; (2) present the owner or operator with a modified plan that would be acceptable; or (3) request Part B of the permit application and begin permitting procedures.

If the Regional Administrator disapproves the plan, he must state his reasons for disapproval and the owner or operator must submit a new plan for approval. Another possible approach to resolving the problems associated with an inadequate closure plan is for the Regional Administrator to present the owner or operator with a modified closure plan that would be approved if the owner or operator agreed to comply with its specifications. The third option is for the Regional Administrator to request Part B of the permit application and commence the permitting process. An approved closure plan will therefore become part of the permit conditions.

13.1.2 Submitting the Post-Closure Plan

"The owner or operator of a disposal facility must submit his post-closure plan to the Regional Administrator at least 180 days before the date he expects to begin closure. The Regional Administrator will modify or approve the plan within 90 days of receipt and after providing the owner or operator and the affected public (through a newspaper notice) the opportunity to submit written comments. The plan may be modified to include security equipment maintenance under §265.117(b)."*

An owner or operator who closes a facility during interim status must also submit the post-closure plan at least 180 days before closure begins. The Regional Administrator has 90 days in which to review the plan and either approve, modify, or disapprove it. During interim status, the post-closure plans may not be frequently reviewed, and therefore, it is important that the plan be submitted well in advance of closure to allow time for modifications, if necessary. Modifications of the post-closure plan may be necessary if:

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*EPA Interim Status Standards, 40 CFR §265.118(c).

- The Regional Administrator's judgment differs from the owner's or operator's judgment (e.g., disagreement over the extent of maintenance required for the cover, replanting schedules);
- The ground-water monitoring program is inadequate;
- The Regional Administrator requires maintenance of any or all of the security systems needed during operation which were not included in the post-closure plan;
- The owner or operator fails to include provisions for additional maintenance required on a periodic basis (e.g., repairs needed as a result of predictable adverse weather conditions, well replacements); or
- Other problems which may result.

The same procedures apply to the approval process of post-closure plans as to closure plans.

13.1.3 Inspecting the Facility

During interim status, the closure and post-closure plans must be available at the facility at all times and are subject to inspection by an EPA official administering Subtitle C of these regulations or an approved state program official. The official should make periodic inspections to check the plans to help reduce the number of inadequate plans submitted at the time of closure. Since the closure plan must be based on the maximum extent of operation unclosed at any given time and must include an estimate of the maximum amount of inventory expected to accumulate over the life of the facility, assuming normal operating conditions, an inspector can check these portions of the plan by looking at the facility conditions.

Periodic inspections can also eliminate some of the problems that are caused by misunderstandings and confusion about the intent of the regulations. The official making the inspections should review the ground-water monitoring plans described in the closure and post-closure plans. Since the implementation of the ground-water monitoring program will not be required until one year after the effective date of the regulations and the owner or operator may have no previous operating experience, it is likely that the program described in the closure plan may require some modifications. If an inspection of the plans shows that the activities described are not appropriate for that facility, the Regional Office should discuss with the owner or operator the problems, explain the intent of the requirements, if necessary, and advise him to revise the plans. If the owner or operator fails to prepare an adequate plan, the Regional Office has the option to begin permit proceedings immediately, which involves the procedures discussed in Sections 13.1.1 and 13.1.2.

13.2 CLOSURE PROCEDURES

13.2.1 Closure Schedule

The closure period begins with the final acceptance of wastes. "Within 90 days after receiving the final volume of hazardous wastes, the owner or operator must treat all hazardous wastes in storage or in treatment, or remove them from the site, or dispose of them on-site, in accordance with the approved closure plan."*

In order to help prevent the possibility of environmental damages caused by the accumulation of wastes without proper plans for timely management, the regulations require that all wastes be treated, disposed or removed within 90 days after receiving the final volume of hazardous wastes. An owner or operator must either complete whatever treatment processes are needed, if any, and dispose all wastes on-site within 90 days or make arrangements to remove all wastes, or any that cannot be managed on-site within the allotted time, off-site within 90 days. A Regional Administrator may grant an owner or operator a longer period of time to manage inventory if routine treatment processes, of necessity, take longer than 90 days. This is an especially likely situation for some kinds of treatment facilities. For example, if the most appropriate method for removing free liquids from a surface impoundment is evaporation, treatment may take longer than 90 days. Similarly, a surface impoundment which relies on biological treatment and is only seasonally aerobic may require more than 90 days to complete treatment of inventory. The 90-day limitation presents special problems to an owner or operator of a land treatment facility. If the facility contains no hazardous wastes at the time of closure, as is intended at some facilities, post-closure care is not required. The treatment processes, however, take much longer than 90 days to complete; therefore, it is important for an extension to be granted to allow the facility to operate as intended and render the wastes non-hazardous or less hazardous.

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*EPA Interim Status Standards §265.113(a).

"The owner or operator must complete closure activities in accordance with the approved closure plan and within six months after receiving the final volume of wastes. The Regional Administrator may approve a longer closure period under §265.112(c) if the owner or operator can demonstrate that: (1) the required or planned closure activities will, of necessity, take him longer than six months to complete, and (2) that he has taken all steps to eliminate any significant threat to human health and the environment from the unclosed but inactive facility."*

The Regional Administrator should use his discretion in determining an appropriate closure period. For example, if a substantial amount of construction activity is required at a large landfill at the time of closure, adverse weather or other unexpected conditions may make a six-month closure period impossible. This six-month closure period presents particular difficulties to an owner or operator of a land treatment facility. The objective of land treatment is to apply hazardous wastes to the soil in order for biological degradation or chemical reactions occurring in or on the soil to render the wastes less hazardous or non-hazardous. This process, which includes periodic retilling of the soil, will frequently take longer than six months to complete. Assuming that the facility is operating properly and the Regional Administrator is satisfied that the owner or operator is acting in good faith, an extended closure period would be justified.

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*EPA Interim Status Standards, 40 CFR §265.113(b).

If an owner or operator must take longer than six months to complete closure, he must ensure that all steps have been taken to eliminate any significant threat to human health and the environment from the facility. The Agency intends that an owner or operator of a well-operated facility will continue the kinds of standard operating procedures routinely used to eliminate the threat of pollution. The provision has been included as a specific requirement in the regulation to allow for certain emergency measures that the Regional Administrator may deem necessary. For example, if at closure the hazardous wastes are leaching into the ground water, the Regional Administrator will likely require more extensive pumping and other activities as part of closure procedures to mitigate the problems.

13.2.2 Revising Closure Plans During Closure

The professional engineer's certification certifies that closure has been performed in accordance with the closure plan. Therefore, if during the closure period the owner or operator finds it necessary to alter some of the procedures, the owner or operator must revise the closure plan to reflect these changes. Any such changes that the owner or operator deems necessary during the process of closing the facility must be approved by the Regional Administrator. Possible changes include:

- Changes in the closure schedule which affect the length of the closure period by greater than one month (e.g., severe weather conditions which halt construction activities, equipment breakdowns); and
- Contingencies which affect what needs to be done to adequately close the facility.

13.2.3 Closure Certification Procedures

"When closure is completed, the owner or operator must submit to the Regional Administrator certification both by the owner or operator and by an independent registered professional engineer that the facility has been closed in accordance with the specifications in the approved closure plan."*

The required certifications only represent a guarantee that closure activities have been performed in accordance with the approved closure plan. The certification applies to all activities performed as part of the closure including all partial closures. Official inspectors should also periodically check the facility during the closure period, as well as after receiving the professional engineer's certification, to increase the Regional Office's confidence that the facility has been adequately closed. In the event that the Regional Administrator finds that closure has not been performed in accordance with the approved plan, he has the authority to require the additional activities necessary to comply with the plan.

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*EPA Interim Status Standards, 40 CFR §265.115.

Owner or Operator Certification

The owner or operator must certify that the activities performed in closing the facility are in accordance with the specifications of the closure plan previously approved by the Regional Administrator. The owner or operator is not guaranteeing the technical adequacy of closure, but rather that the closure plan, as approved by the Regional Administrator, was carried out. Accordingly, the certification will be straightforward, no matter how complex closure itself will be. An example of a certification follows.

I, ____, of
owner or operator

____
name and address of hazardous waste facility

hereby state and certify that, to the best of my knowledge and belief, the above-named hazardous waste facility has been closed in accordance with the attached approved closure plan, and that the closure was completed on the ___day of ____________________, 19___.

____
signature

____
date

Professional Engineer Closure Certification

An independent registered professional engineer(s) must certify that the facility has been closed in accordance with the approved closure plan. The engineer is not certifying the adequacy of the activities or the plan; he is certifying only that, in his judgment, the activities performed were in accordance with the specifications in the approved plan. EPA does not expect that the engineer will spend large periods of time on the site, observing all partial closures and final closure. Rather, the Agency expects that the engineer will periodically visit the site and inspect the closure activities. Since all closure activities, including partial closures, must be certified by a professional engineer, and a professional engineer will generally need to observe the activity while it is being performed, an owner or operator may find it most practical to have a professional engineer certify partial closures as they are completed. At final closure the professional engineer who certifies that closure has been completed can rely in part on earlier certifications of partial closures and in part on his inspections of the facility as a whole to ensure that the partially closed areas have been maintained. The following is a sample professional engineer certification:

I, ____, a certified professional engineer, hereby certify, to the best of my knowledge and belief, that I have verified that Professional Engineer Closure Certificates were issued for all prior closure activities at

____ and
hazardous waste facility

that I have made visual inspection(s) of the aforementioned facility, and closure of the aforementioned facility has been performed in accordance with the closure plan for the facility approved by the Regional Administrator for Region_____ of the United States Environmental Protection Agency.

______________________________ ______________________________
signature date

____
State Professional Engineer License No., issued by the State of

____
business address and telephone number

13.3 POST-CLOSURE PROCEDURES

13.3.1 Effective Date of Post-Closure

The date that the independent professional engineer signs the closure certificate is the effective date of post-closure. The owner or operator should begin post-closure activities on that date in accordance with the approved post-closure plan.

13.3.2 Notice to Local Land Authority

"Within 90 days after closure is completed, the owner or operator of a disposal facility must submit to the local land authority and to the Regional Administrator a survey plat indicating the location and dimensions of landfill cells and other disposal areas with respect to permanently surveyed benchmarks....The plat filed with the local land authority must contain a note, prominently displayed, which states the owner's or operator's obligation to restrict disturbance of the site as specified in §265.117(c)."*

Within 90 days from the date that the professional engineer has certified closure, the owner or operator must submit to the local land authority and to the Regional Administrator a survey plat prepared and certified by a professional land surveyor. The surveyor is responsible for preparing and certifying a plat, which indicates the location and dimensions of cells or trenches. The plat can be prepared from the operating log of the facility. The purpose of the survey plat is to provide information if problems arise after the operating period, if resources are to be recovered, or if it is necessary to locate water mains, power lines, etc. The plan also must contain a note, prominently displayed, which states the owner's or operator's obligation to restrict disturbance of the facility as specified in §265.117(c). The plat and note are filed with the local land authority, i.e., the authority that keeps records of all deeds so that future users and purchasers of the land who would check the deeds would be alerted to the contents and restrictions on the use of the land. The owner or operator must also submit a record of the type, location and quantity of wastes disposed within each area of the facility. This information should be obtained from operating records; for wastes treated or disposed before the promulgation of the regulations, the owner or operator should provide the information to the best of his knowledge.

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*EPA Interim Status Standards 40 CFR §265.119.

A sample note to accompany the survey plat is as follows:

This plat describes real property in which hazardous wastes have been disposed and buried in accordance with requirements of 40 CFR §265. Although the hazardous waste disposal facility is now closed, public health, environmental safety, and regulations issued by the United States Environmental Protection Agency at 40 CFR §265.117(c) require that post-closure use of the property never be allowed to disturb the integrity of the final cover, liner(s) or any attached containment system unless it can be demonstrated that any proposed disturbance will not increase any risk to the public or the environment.

Your attention is directed to the accompanying list of wastes, described by type and location, buried at the above-described facility.

____
owner's or operator's signature

____
date

13.3.3 Revising Post-Closure Plans During Post-Closure

Any modifications and revisions to post-closure care made during the post-closure period must be approved by the Regional Administrator and reflected in a revised post-closure plan. See Section 11.2, "Revising Post-Closure Plans," for a discussion of plan revisions.

13.3.4 Notice in Deed to Property

"The owner of the property on which a disposal facility is located must record, in accordance with State law, a notation on the deed to the facility property -- or on some other instrument which is normally examined during title search -- that will in perpetuity notify any potential purchaser of the property that: (1) the land has been used to manage hazardous waste, (2) its use is restricted under §265.117(c), and (3) the survey plat and record of the type, location and quantity of hazardous waste disposed of within each cell or area of the facility required in Section 265.119, is on file with the local land authority and the Regional Administrator of the Environmental Protection Agency."*

The difficulties at Love Canal in New York were compounded by the fact that individual owners of the land containing the leaching chemical wastes had no knowledge prior to their purchase of the land that there was anything untoward buried beneath its surface. To prevent this from happening again, the EPA in §265.120 of the regulations has required owners of property where hazardous wastes are disposed to record a notation on the deed or other instrument that is normally examined during title search that will alert all future purchasers of the land that hazardous waste has been disposed on the property, and that the use of the property is restricted under §265.117(c), and that the survey plat recording the types, location and quantities of disposed wastes is on file with the local land authority and the Regional Administrator.

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*EPA Interim Status Standards, 40 CFR §265.120.

Conceptually, the problem and the solution are straightforward -- any facility owner or operator disposing or treating hazardous wastes under the regulations must give sufficient written notice to the local land authorities to alert any subsequent purchasers of the land of its contents and restrictions on its use. Administration of this requirement cannot be as straightforward as the concept because local property law and local recording requirements vary from jurisdiction to jurisdiction across the country. The form of the notice, therefore, can be expected to vary state by state and even within states. It is up to the Regional Offices to ensure that the essential content of the notice does not vary.

The minimum requirements of notice under §265.120 are as follows:

TO WHOM IT MAY CONCERN:

______________________________________ the undersigned,
owner

of____, City
street address

of_________________________, County of________________, State

of_________________________, hereby gives the following notice as required by 40 CFR §265.120:

1. I am, and since _________, 19___ have been in possession in fee simple of the following described lands __________________________
____
(legal description)

2. Since __________, 19___, I have disposed of hazardous chemical wastes under the terms of regulations promulgated by the United States Environmental Protection Agency on/in the above-described land.

3. The future use of the above-described land is restricted under the terms of 40 CFR §265.117(c).

4. Any and all future purchasers of this land should inform themselves of the requirements of the regulations and ascertain the amount and nature of wastes disposed on the above-described property.

5. I have filed a survey plat with the local land authority and with the Regional Administrtor of EPA showing the location and dimensions of landfill cells and a record of the type, location and quantity of waste disposal within each area of the facility.

The notice should be signed by the owner of the land, and the signature notarized. The Regional Offices of the Agency should make sure that such notice is filed in accordance with local recording requirements by obtaining a duly stamped as received copy from the local land authority. The Regional Offices should be aware that different jurisdictions have different technical requirements for acknowledging documents relating to land or verifying them. The outline above is only a skeleton reflecting the gist of §265.120, and will necessarily be fleshed out by local requirements. Variations in language and structure which do not affect the information to be conveyed in the form above should be acceptable to the Regional Offices if there is proof that the local land authority in question has accepted and filed the notice in the index most likely to be checked by later purchasers.

13.3.5 Post-Closure Security Requirements

Section 265.117(b) of the interim status regulations states that:

"The Regional Administrator may require maintenance of any or all of the security requirements of §265.14 during the post-closure period, when:

(1) Wastes may remain exposed after completion of closure; or

(2) Short term, incidental access by the public or domestic livestock may pose a hazard to human health."

The interpretation of this section is up to the discretion of the Regional Administrator. However, it may be noted that the situation in which wastes remain exposed after the completion of closure will be rather unusual, since this would imply that closure would have been completed without any cover. Even a land treatment facility would not normally commence post-closure until all possible treatment was completed and at least a vegetative cover had been established. The prevention of short-term incidental access may normally be accomplished through the use of a posted fence. In most cases, this will be necessary to prevent incidental access and may be necessary in any situation where the burial of hazardous waste is relatively shallow. This would particularly be the case for a land treatment facility which still contained hazardous wastes under only a vegetative cover. It would also be desirable to have this level of security for a surface impoundment or landfill in which the burial of the wastes was relatively shallow (i.e., under, at most, 2 to 3 feet of cover). The requirement for security might, however, be foregone in situations where the containment is extremely stringent and where the wastes are buried so deeply that it would be extremely unlikely for surface vegetation to contain any hazardous wastes or for incidental contact to cause potentially serious erosion problems or other uncovering of the hazardous wastes.

13.3.6 Post-Closure Property Use

The regulations require that, whatever the property use, there must be assurance that the use of the property "never be allowed to disturb the integrity of the final cover, liner(s), or any other components of any containment systems or the function of the facility's monitoring systems unless the owner or operator can demonstrate to the Regional Administrator either in the post-closure plan or by petition that the disturbance: (1) is necessary to the proposed use of the property, and will not increase the potential hazard to human health or the environment; or (2) is necessary to reduce a threat to human health or the environment."*

In general, the post-closure plan should indicate the proposed post-closure property use, and either demonstrate that such use will not disturb the integrity of the containment system or demonstrate the necessity of such disturbance. If this has not been covered in the post-closure plan, it may later be altered by a petition. In general, this requirement should be interpreted stringently; any property use with the potential to cause erosion of the final cover should be prevented unless the owner or operator can demonstrate that the disturbance is necessary and that adequate provision has been made in the post-closure plan for erosion control measures. The integrity of the final cover may, of course, also be disturbed if it is necessary in order to contain potential threats to health or the environment; however, even in these situations, the necessity must be firmly demonstrated to the Regional Administrator.

12.3.7 Duration of Post-Closure Requirement

Section 265.117(d) states that "the owner or operator of a disposal facility must provide post-closure care in accordance with the approved post-closure plan for at least 30 years after the date of completing closure." However, two kinds of exemptions to this requirement are provided for in the regulations. First, the owner or operator may "petition the Regional Administrator to allow some or all of the requirements for post-closure care to be discontinued or altered before the end of the post-closure period." It should be noted that some of the requirements may be discontinued without discontinuing all post-closure requirements. The period of post-closure may also be extended: "The Regional Administrator may require the owner or operator to continue one or more of the post-closure care and maintenance requirements contained in the facility's post-closure plan for a specified period of time." The regulation also notes that "anyone (a member of the public as well as the owner or operator) may petition the Regional Administrator for an extension or reduction of the post-closure care period based on cause. These petitions will be considered by the Regional Administrator at the time the post-closure plan is submitted and at five year intervals after the completion of closure." To summarize, while the post-closure care period is set for 30 years, either all or a portion of the requirements may be shortened through a petition to the Regional Administrator, or lengthened for specified periods either as a result of petition or at the direction of the Regional Administrator.

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*EPA Interim Status Standards, 40 CFR §265.117(c).

The most obvious situation in which a reasonable case could be made for discontinuing post-closure care requirements would be that in which it could be demonstrated that the wastes have been rendered non-hazardous or that they have been removed. In the case of organic hazardous wastes, natural soil processes could have the effect of rendering the wastes non-hazardous. This could be demonstrated by a suitable statistical sample of soil probes. Such a situation would probably be most likely to occur at a land treatment facility, where organic wastes were not fully rendered non-hazardous at the time closure was completed, or at a surface impoundment which was closed as a disposal facility and where the remaining waste materials were organic.

It is also possible, under some circumstances, that wastes might be removed. Wastes might be removed if: (1) problems at the facility made it less expensive to remove wastes to another facility than to continue waste disposal on-site; (2) improvements in technology allowed methods of rendering the wastes non-hazardous that were less expensive than continuing post-closure care; and (3) changes in costs of material or recycling technology made it more advantageous to mine and recycle material that had previously been treated as hazardous wastes.

If hazardous wastes are not rendered non-hazardous or removed, the question of the proper duration of post-closure requirements is extremely difficult to answer. The same problems occur when one is dealing with a petition to shorten the post-closure care period or when deciding whether the post-closure care period should be extended beyond 30 years. A demonstration that no leaks have occurred to date cannot, in and of itself, be considered adequate grounds for eliminating all or a portion of post-closure care requirements. The absence of leaks or runoff problems does not demonstrate the absence of need for post-closure care for two reasons:

1. Future events may occur such that past performance may not be repeated. One problem that should be given specific attention in this line is that of wastes that have been disposed of in drums. It may be that it is the barrels themselves, rather than the cover, vegetation, and underlying soil, which has prevented leakage in the past. However, barrels underground can be expected to decay and begin leaking 10 to 30 years after original placement. As a result, when waste has been disposed of in containers, even an extended period of no leaks does not provide proof of the adequacy of the larger containment system. A second possible problem is that the viability of various kinds of synthetic membranes over long periods of time in the ground remains uncertain.

2. The absence of leaks may be the direct result of post-closure care, and the absence of this care may lead directly to environmental or health damages. In the absence of some experiments, with the approval of the Regional Administrator, it is difficult to determine to what

extent control has been maintained precisely because of the post-closure care. For example, post-closure care will typically include extensive measures to prevent erosion and the development of deep rooted vegetation. It may be unclear, in the absence of some experiments, to what extent erosion or deep rooted vegetation would cause problems in the absence of post-closure care. The Regional Administrator may thus wish to consider the possibility of allowing the owner or operator to forego certain steps in his post-closure care plan while continuing inspections, with the possibility that these steps may need to be restored if inspection shows problems developing in their absence.

It should be noted that even if the Regional Administrator decides to discontinue some requirements of post-closure care, as long as hazardous wastes remain, post-closure use of property must not be allowed to deter the integrity of the containment system, the notice to local land authorities must remain in effect, and the notice in the deed to property must remain in effect.

The Regional Administrator must consider and respond to any petition for an extension or reduction of the post-closure care period. Any letter from the general public or the owner or operator requesting an extension or reduction of the post-closure care period, or one from the owner or operator requesting a reduction in post-closure care requirements, must be considered as a petition. In response to the petition, the Regional Administrator must, at a minimum, file a formal written response as part of the public record for the facility concerned. He may, but is not required to, seek public comment on the suggestions offered in any petition.

A petition from the owner or operator to alter some of the post-closure requirements can take any form, but should include at a minimum, the following information:

- Identification of the facility;
- Identification of the current post-closure requirements for which an alteration is proposed;
- The proposed alterations (the description of the current requirements and the proposed changes should be presented in the petition so they can be readily compared); and
- Technical justification, as detailed as possible, demonstrating that the proposed alterations will not cause a threat to human health or the environment.

A petition from the owner or operator or the general public to reduce the length of the post-closure care period should include, at a minimum, the following information:

- Identification of the facility;
- Suggested extension or reduction (in years); and
- Justification for the alteration
  - If the request is to extend the time period, the petition should provide evidence that either the facility is not complying with applicable standards or requirements, or will pose a specific threat to human health or the environment if the post-closure care period is not extended; or
  - If the request is to reduce the time period, the petition may demonstrate that: the material is no longer hazardous either because it has been removed or transformed; the control system is adequate in the absence of specific care measures; or the facility poses no threat even if containment should prove less than ideal.

When considering an extension to the post-closure care period or responding to such a petition, the Regional Administrator has the following options:

1. He may extend the post-closure care period for a specified period of time, which is at his discretion, with the possibility of further extensions. This extension must be justified by either evidence that the facility has not complied with standards or requirements, or specific identification of the possible threats to human health or the environment which make this extension necessary.

2. The Regional Administrator may choose not to extend the period of care and/or deny a petition for this purpose if no one has adequately demonstrated that the facility is not in compliance or there is inadequate proof that the facility would pose a threat to human health and the environment if the post-closure care period were not extended.

The Regional Administrator may respond to a request for a reduction in care requirements during the 30-year period in one of the following ways:

1. He may grant a temporary or experimental alteration of requirements. No change in the cost estimate or financial responsibility requirements would be required, but it must be demonstrated that a temporary stay would not pose a threat to human health or the environment.

2. The Regional Administrator may grant a permanent alteration to post-closure care requirements. In this case, the post-closure cost estimate and resulting post-closure financial responsibility would have to be changed and accompanied by evidence that the alteration would not result in a threat to human health or the environment.

3. The request could be rejected on the grounds that inadequate proof had been offered to demonstrate that the proposed alteration provided adequate protection to human health and the environment.

It should be noted that in all cases it is the petitioner that must demonstrate that the proposed alterations, including a reduction in care requirements and a reduction in the time period, do not increase the threat to human health and the environment.